# CPU®
## COMPUTER POWER USER



**MODDER Q&A**
Marc "marcam923" Molella

# PROJECT
# WIFEY

TRAVIS FADER BUILT A GORGEOUS
GAMING RIG FOR HIS BETTER HALF
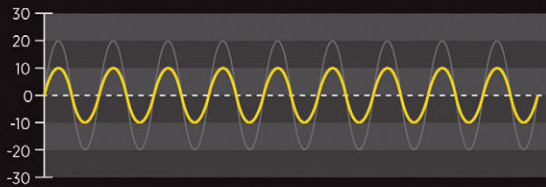
# RMi & RMx Series
# Power Supplies

**RM750x**

# SETTING THE GOLD STANDARD

CORSAIR RMi and RMx Series power supplies are 80 PLUS Gold certified, giving you superb power efficiency, virtually silent operation and a fully modular cable set.

## FEATURES

Engineered for extremely tight voltage regulation and best-in-class ripple and noise suppression.

RMi: Represents < 20mV of ripple at full load on RM1000i

Brand X: Represents 40mV of ripple at full load on other leading brand 1000W PSU

**Zero RPM Fan Mode** delivers silent operation at low and medium loads.

dB @ 25°C AMBIENT

POWER OUTPUT (WATTS)

100% Japanese 105°C capacitors ensure reliability and long life, backed by a 10 year guarantee

**CORSAIR LINK** — RMi only

**CORSAIR LINK** makes it easy to monitor power supply performance, toggle between single and multiple +12V rail modes, and control fan speed directly from your desktop.
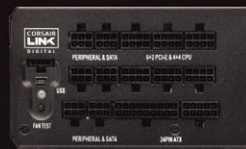
**Fully Modular Cables** allow for quick and easy installation and great looking builds, or upgrade your system with Type 4 Premium Sleeved Cables *(sold separately)*.

RM1000i

BUILD IT BETTER

**26**
Mad Reader Mod: Project Wifey by Travis Fader



**44**
Titans Of eSports: Counter Logic Gaming

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Sandhills Publishing®

## EVGA Announces Two Closed-Loop Coolers With RGB & Flow Control

EVGA has added two new closed-loop liquid CPU coolers to its product portfolio. The new EVGA CLC 120 and EVGA CLC 280 feature new EVGA fans, one 120mm for the 120 and two 140mm for the 280, that the company says have a new blade design and "Teflon Nano" bearings to produce better cooling at lower noise levels. The coolers also have RGB lighting that can sync up with select models of EVGA cards. Color setting preferences can be saved to firmware.

EVGA says it has new Flow Control software on the way that will let users control fan speed, pump speed, RGB lighting, and other settings. Other features the coolers offer include fully sleeved tubing and a five-year warranty. Both coolers come prefilled so you just plug and play. MSRPs are $89.99 for the CLC 120 and $129.99 for the CLC 280.

## AMD Announces First Three Ryzen Models; Sets Launch For March 2

AMD has been teasing information about its new Ryzen processor lineup since CES in January, but we now have more details and a firm release date. The company plans to launch its first three Ryzen chips—the 1800X, 1700X, and 1700—March 2. The 1800X has base/boost clock speeds of 3.6GHz/4GHz and TDP of 95 watts. The 1700X has base/boost of 3.4GHz/3.8GHz and the same TDP. The 1700 has base/boost of 3GHz/3.7GHz but sips just 65 watts of power. The 1700 also will be the only one of the three to ship with a cooler, AMD's new Wraith Spire. The company says the cooler operates at a quiet 32 decibels. Preorders in the U.S. for the new Ryzen processors are being taken by three retailers: Amazon, Newegg, and Micro Center. The 1800X/1700X/1700 processors carry MSRPs of $499, $399, and $329, respectively.

## WATCHING THE CHIPS FALL

Here is the pricing information for various AMD and Intel CPUs.

| CPU | Released | Original Price | Last Month's Price | Online Retail Price* |
|---|---|---|---|---|
| AMD Ryzen 7 1800X | 3/2/2017 | $499 | N/A | $499 |
| AMD Ryzen 7 1700X | 3/2/2017 | $399 | N/A | $399 |
| AMD Ryzen 7 1700 | 3/2/2017 | $329 | N/A | $329 |
| AMD FX-9590 Eight-Core (Vishera) | 6/11/2013 | n/a | $199.99 | $189.99 |
| AMD FX-8370 (Vishera) | 9/2/2014 | $199.99 | $184.99 | $189.99 |
| AMD A10-7890K (Godavari) | 3/1/2016 | $164.99 | $148.99 | $148.99 |
| AMD A10-7870K (Godavari) | 5/28/2015 | $137 | $157.99 | $124.99 |
| AMD A10-7860K (Godavari) | 2/2/2016 | $116.99 | $114.99 | $109.99 |
| AMD Athlon X4 880K (Godavari) | 3/1/2016 | $94.99 | $96.40 | $91.86 |
| AMD Athlon X4 845 (Carrizo) | 2/2/2016 | $69.99 | $67.99 | $67.99 |
| Intel Core i7- 6950X (Broadwell E) | 5/31/2016 | $1,723** | $1,649.99 | $1,644.99 |
| Intel Core i7- 5960X Eight-Core (Haswell) | 8/29/2014 | $999** | $1,084.66 | $1,095.74 |
| Intel Core i7- 6900K (Broadwell E) | 5/31/2016 | $1,089** | $1,049.99 | $1,049.99 |
| Intel Core i7- 6850K (Broadwell E) | 5/31/2016 | $617** | $609.99 | $609.99 |
| Intel Core i7- 5930K Six-Core (Haswell) | 8/29/2014 | $583** | $613.64 | $619.29 |
| Intel Core i7-5820K Six-Core (Haswell) | 8/29/2014 | $389** | $389.99 | $409.26 |
| Intel Core i7-6700K Quad-Core (Skylake) | 8/5/2015 | $359** | $339.99 | $339.99 |
| Intel Core i7-4790K Quad-Core (D.Canyon) | 6/25/2014 | $339** | $339.99 | $408.78 |
| Intel Core i7-4790 Quad-Core (Haswell) | 5/11/2014 | $303** | $304.99 | $333 |
| Intel Core i5-6600K Quad-Core (Skylake) | 8/5/2015 | $249** | $239.99 | $239.99 |

* As of February 2017
** Manufacturer's estimated price per 1,000

## MSI Adds Four More ARCTIC White Boards To Arsenal GAMING Lineup

MSI is adding four more ARCTIC white motherboards to its Arsenal GAMING Series lineup. The Z270/H270 TOMAHAWK and the H270M/B250M MORTAR ARCTIC boards feature distinct plated armor and the white color scheme that mark the ARCTIC design. The Z270/H270 support dual M.2 slots for storage and RAID 10/1/5/10. They are both ATX boards, while the H270M and B250M are microATX. The Z270 TOMAHAWK also supports faster memory than the other boards and can handle 64GB of DDR4 to 3,800MHz (OC). The other three boards top out in memory support at 2,400MHz. MSI says its new ARCTIC white motherboards have fully isolated memory circuits that help protect against EMI (electromagnetic interference) and reduce system crashes. The boards also feature enhanced audio specs and have special networking technology that helps maximize gaming speeds.

## EKWB Announces Monoblock For GIGABYTE Z270X Motherboards

EK Water Blocks has announced a new waterblock designed specifically for GIGABYTE Z270X motherboards. The block comes with RGB LEDs and works with GIGABYTE's RGB Fusion lighting control software. The EK-FB GA Z270X RGB Monoblock cools Intel LGA-1151 socket CPUs (Kaby Lake and Skylake) as well as the MOSFET power regulation areas. The waterblock's base is made of electrolytic copper that is nickel-plated; the top is made of acrylic. EKWB says the waterblock is compatible with nine GIGABYTE boards: AORUS GA-Z270X-Gaming 7; AORUS GA-Z270X-Gaming K7; AORUS GA-Z270X-Gaming 5; AORUS GA-Z270X-Gaming K5; GA-Z270X-Ultra Gaming; GA-Z270X-UD5; GA-Z270-Phoenix Gaming; GA-Z270-Gaming 3; and GA-Z270-Gaming K3. MSRP for the EK-FB GA Z270X RGB Monoblock is $136.99.

## Lian Li Releases Two-Chamber PC-O11

Lian Li has officially launched the PC-O11, an aluminum-and-steel chassis with tempered-glass panels on the front and side. The case handles motherboards up to E-ATX and measures 506 x 277 x 457 (HxWxD, in mm). The case is another of the company's two-chambered models, with a main chamber for showing off your motherboard and other main components, and a smaller back chamber that hides the power supply and drive cages. The cages hold up to four 3.5-inch and two 2.5-inch drives, or six 2.5-inch drives. If you need more storage room than that, you can mount 2.5-inch drives on any of the 16 (!) fan mounts that are inside the chassis. The main chamber is capacious and can hold 360mm radiators on both the top and bottom. There's also room to place a 360mm rad up front, if you choose to remove the fan bracket that's meant to hold up to three 120mm fans. The case can handle graphics cards up to 430mm long and CPU coolers up to 150mm tall. It has eight expansion slots. MSRP for the new PC-O11 is $229.99.

## Noctua Ships Coolers For AMD Ryzen

Noctua has begun shipping three special editions of existing coolers that are designed to work with AMD's new AM4-socket CPUs. The three coolers with designated SE-AM4 versions are the NH-L9x65, the NH-U12S, and the NH-D15. Noctua says the coolers will offer new Ryzen owners three distinct usage scenarios. The NH-L9x65 SE-AM4 is a compact cooler for users with small-form-factor systems, while the NH-U12S SE-AM4 is a midsized cooler and provides increased cooling capacity. The NH-D15 SE-AM4 is the cooler with the greatest cooling capacity and is meant for enthusiasts who are overclocking and pushing high-end processors to their performance limits. The special-edition coolers will come with a new mounting system for the AM4 socket called SecuFirm2. MSRPs are as follows:

- NH-D15 SE-AM4 = $99.90
- NH-U12S SE-AM4 = $64.90
- NH-L9x65 SE-AM4 = $52.90

**HARDWARE MOLE**
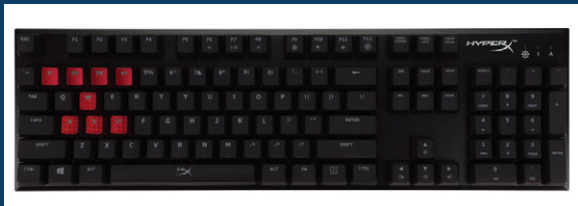
## HyperX Ships New Alloy FPS Planks

HyperX, the extreme gaming brand for Kingston Technology, is now shipping new versions of its Alloy FPS mechanical gaming keyboard. The two new versions of the plank come with Cherry Red (linear, quiet audio feedback) or Cherry Brown (tactile, balanced audio feedback) switches. These models join the original HyperX Alloy FPS, which began shipping in the U.S. in October. The first version of the plank came with Cherry Blue (click, loud audio feedback) switches. The Alloy FPS models are compact models that come with a mesh carrying bag for easy transport to LAN events. The keyboards are made for gaming and feature full N-key rollover, 100% anti-ghosting, and a Game Mode that helps ensure uninterrupted gaming play by disabling the Windows key. MSRP for the HyperX Alloy FPS is $99.99.

## BIOSTAR Announces Three Ryzen Motherboards, Including X370GT7

BIOSTAR is adding three motherboards to its RACING SERIES that support AMD's new Ryzen processors. The new boards are the RACING X370GT3, the RACING B350GT3, and the RACING X370GT7. The latter board is the flagship of the Socket AM4 boards and includes M.2 Cooling Protection to maintain optimal SSD performance. BIOSTAR says the X370GT7 will be offered in a bundle with the company's M22 M.2 240GB SSD. All three of the motherboards feature VIVID LED Armor and 5050 LED Fun Zone software that lets users customize their systems. Also new with the release of these boards is the company's FLY.Net software that optimizes network performance when gaming.

## Apps Transform How We Interact With Each Other & The World

In 2016, smartphone users downloaded more than 90 billion apps (up 15% from 2015) and spent about 900 billion hours using the apps on their phones (up 25%), according to a study by the analytics and market intelligence group App Annie. "Apps are transforming how we interact with the world and each other," said App Annie's Eric Thompson. The App Annie report looked at data from both the iOS App Store and Google Play and found that apps (excluding games) contributed more to overall download growth than games. On the App Store, top growth categories were finance, travel, and photo and video; on Google Play, the top categories by growth were productivity, tools, and social. Compared to iOS, Android is especially prevalent among developing markets, according to App Annie, where new users are downloading app "essentials." In more developed markets, where iOS is better represented, users likely have already downloaded essential apps.

## Ad-Blocker Use Is Growing "Explosively," Report Says

About 11% of internet users worldwide use an ad-blocking program, equating to about 615 million devices housing such software, according to the "2017 Adblock Report" from PageFair. In 2016, use of ad-blockers climbed 30% globally, the company reports. PageFair's research indicates that usage of mobile device ad-blocking software rose by 108 million devices in 2016 to reach 380 million active devices. Desktop usage of blockers, meanwhile, climbed by 34 million to hit 236 million devices—that despite the fact that "ever smaller numbers of people" are using desktop and laptop computers, PageFair states. In terms of regional usage, PageFair found that mobile ad-block usage is growing explosively in Asia and is set to spread to North America and Europe. Specifically, the company's data indicates that mobile ad-block usage "surged" by 40% in the Asia-Pacific region last year.
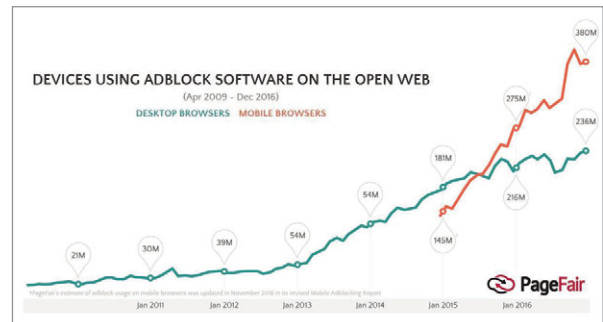


## SOFTWARE SHORTS

## Newest Version Of LibreOffice Improves Functionality & Interface

The LibreOffice office suite was first released about six years ago, but the latest version, 5.3, marks one of the most feature-rich releases The Document Foundation says it has ever produced. There are new features such as collaborative editing, which increase its competitiveness with other offerings, the foundation notes, along with incremental improvements that add to the program's reliability, interoperability, and user-friendliness. In its six-year history, LibreOffice has attracted more than 1,100 developers, said Michael Meeks, a board member of The Document Foundation. In the past two years, he said, the foundation has had an average of 300 people active on the source code. Those volunteers have contributed toward making LibreOffice 5.3 easier to develop, maintain, and debug.

LibreOffice 5.3 improvements include new features such as a cross-platform text layout engine, a revised Help menu, and better import/export filters to new and legacy Microsoft Office documents. LibreOffice Online allows for basic collaborative editing of documents in a browser. The Writer application lets you more easily apply formatting to a table and also lets you quickly customize page settings or jump to other pages in a document. Calc has new default cell styles, improved compatibility with other spreadsheet software, and a text-entry box to more easily narrow down the functions you're looking for. Impress now starts with a template selector and has a new Slide Properties Deck. You can download the updated office suite at www.libreoffice.org/download.

## Mozilla Effort Aims To Track The Health Of The Internet

Mozilla—a group whose goal is to ensure the internet is a global public resource open and accessible to all—has launched a new open-source initiative to document and explain what's happening to the health of the internet. The Internet Health Report looks at five key areas: Open Innovation, Digital Inclusion, Decentralization, Privacy and Security, and Web Literacy. It attempts to answer questions such as "Who is welcome online?," "Who controls the internet?," and "Who can succeed online?" Right now, Solana Larsen, editor of the report, calls the initiative (in version 0.1) "a snapshot of a moment in time in the life of the internet." It includes articles examining the issues in each key area. Mozilla will be gathering feedback through March, with plans to then work with partners and develop metrics for the initiative. It'll then spend July to September working with allies to shape the next version of the report, which it expects to release during the fourth quarter.

## List Of Most-Used Passwords Remains Consistent

What is 123456? No. 1 on the list of the most-used passwords, according to Keeper Security. That's despite years of work to educate users on the need for creating more unique, stronger passwords. "While it's important for users to be aware of risks, a sizable minority are never going to take the time or effort to protect themselves," said Keeper Security CEO Darren Guccione. His suggestion? "IT administrators and website operators must do the job for them." In creating the list, Keeper Security, which specializes in password management and digital vault software, looked at 10 million passwords from data breaches that occurred in the past year. Four of the top 10 passwords have six characters or fewer, which means brute-force cracking software and hardware can unscramble them in seconds. Even more clever attempts to secure passwords—1q2w3e4r and 123qwe, for example— are weak because dictionary-based password crackers know how to look for sequential key variations, Guccione notes. Here are the others in the top five: 123456789, qwerty, 12345678, and 111111.
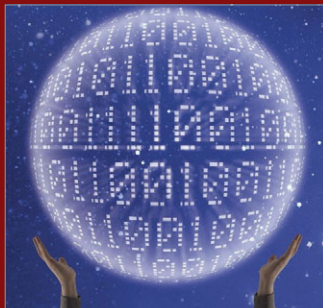


## SITE SEEING

## The Metropolitan Museum Of Art Expands Artwork Available Online

You can now access more than 375,000 images of public-domain artwork for both scholarly and commercial purposes online as part of The Metropolitan Museum of Art's new Open Access policy. Thomas P. Campbell, director and CEO of The Met, described the collection as a comprehensive and diverse museum collection spanning 5,000 years of world culture.

The collection is available as part of the Creative Commons Zero designation and in partnership with Wikimedia, opening access to the collection through Wikipedia. Creative Commons will support search and reuse of The Met collection at ccsearch.creativecommons.org/themet. You'll also find the artwork available at Artstor, the Digital Public Library of America, Art Resource, and on Pinterest.

As the largest encyclopedic art museum in North America, The Met has "given the world a profound gift," said Creative Commons CEO Ryan Merkley. With the new policy, people around the world can "use, remix, and share" the collection "widely and without restriction," Merkley said. The Met is a leader when it comes to providing this type of access and also was among the first museums to offer audio guides, invest in mobile apps, and develop a robust website, according to Bloomberg Philanthropies, which helped make the Open Access initiative possible.
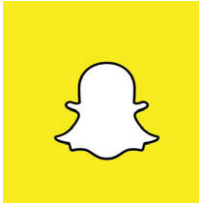
## Job Of The Month

Send a photo to a friend, and then it disappears. It seems like a "well, duh" idea now for a smartphone app, but it was revolutionary at the time Snapchat made it possible, and it has made the company behind it (now called Snap) a legend. Snap is looking for some new technical talent at its Venice, California, headquarters. Applicants for the software engineer position must be "really, really good software engineers" with a BS/BA in CompSci or an equivalent field (M.S. preferred). You need to love big, hairy technical problems, be a whiz at mobile apps and databases, and be able to come up with Eureka! solutions. The more you know about distributed systems, the better. You'll be working on one of the world's most recognizable apps, creating new features and building scalable products. Snap calls itself a "camera company," and it has big designs for the future. If you want to join in on the fun, see the company's website for job details.
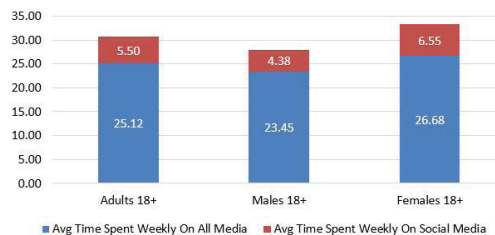
*Source: www.Snap.com*

## We All Like Our Social Media

Some people think all millennials are addicted to posting and texting, but a study by The Nielsen Co. on adult media usage revealed members of Generation X spend more time on social media. The heaviest users of social media, though, are not defined by age or generation, but by gender. Females

### How Much Time Men & Women Spend On Media (Hours Per Week)

| | Adults 18+ | Males 18+ | Females 18+ |
|---|---|---|---|
| Avg Time Spent Weekly On Social Media | 5.50 | 4.38 | 6.55 |
| Avg Time Spent Weekly On All Media | 25.12 | 23.45 | 26.68 |

in general not only spend more time online than males, but they also devote about 25% of their online time to social media sites. Males tend to spend less time online overall and about 19% of that time is spent on social media. Nielsen says while females average a little more than 6.5 hours per week on social media, the heaviest users spend about three hours every day interacting with social media sites.

*Source: The Nielsen Co.*

## Nearly 2/3 Of Americans Have Had A Data Breach

A Pew Internet Research survey on data security and cyberattacks provides some sobering statistics about the extent of cybercrime. A majority of respondents—64%, or nearly two out of three—said they have had their data stolen or been the victim of some type of criminal activity online. The effects of these data breaches range from mildly irritating to financially debilitating, as shown in the table below.
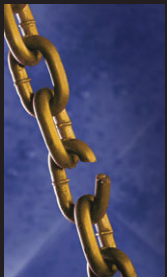
### Percentage Of Americans Who Report They . . .

| | |
|---|---|
| 41% | Have experienced fraudulent credit card charges |
| 35% | Have been notified their information has been compromised |
| 16% | Have had someone take over their email account |
| 15% | Have been notified their Social Security number has been compromised |
| 14% | Have had someone attempt to take out loans or credit lines in their name |
| 13% | Have had someone take over one of their social media accounts |
| 6% | Have had false tax returns filed in their name |

*Source: Pew Internet Research*

## RAW Numbers:

### 10
The percentage of U.S. homes forecast to have some type of robotic housekeeper by the year 2020.
*Juniper Research*

### 110,600
The number of full-time or part-time employees that Amazon added to the company's roster in 2016 (this does not include temporary or contract workers). The giant online retailer started 2016 with 230,800 people and reported it had 341,400 employees as of the end of the year. It now says it intends to add another 100,000 full-time employees this year.
*Amazon.com*

### 9 million +
The number of smartwatches that shipped worldwide during the fourth quarter of 2016. Two-thirds of those products were Apple Watches, which also accounted for some 80% of total smartwatch revenues.
*Canalys*

### 8.4 billion
Number of "things" that will be connected worldwide this year.
*Gartner*

### $14.81 billion
The forecast value of the processor market for IoT (Internet of Things) devices by the year 2022. The market includes chips for all kinds of connected devices, including doorbells, picture frames, thermostats, and automobiles.
*MarketsandMarkets.com*

*". . . GIGABYTE's GA-Z270X-UD5 is a good fit for anyone who plans to tweak voltages and optimize component performance."*



**GA-Z270X-UD5**
$199.99 ● GIGABYTE ● www.gigabyte.us

# GIGABYTE GA-Z270X-UD5

GIGABYTE has designed a UD5 model for just about every modern Intel chipset, going back as far as GA-P55-UD5 for the P55 chipset (at that time, GIGABYTE's boards still had bright blue heatsinks and a blue PCB). Supported devices and connectivity have changed dramatically over the years, yet any board bearing the UD5 name has always featured the best of GIGABYTE's Ultra Durable technology for superb reliability and stability. GIGABYTE typically caters UD5 models to enthusiasts, as well, by adding overclocking conveniences, such as a debug display, voltage read points, and onboard power, reset, and clear CMOS buttons. The GA-Z270X-UD5 brings all the traditional UD5 goodies to the Z270 chipset, plus a visual redesign with silver heatsinks and a silver rear I/O and audio PCB cover.

The Ultra Durable technology baked into the GA-Z270X-UD5 is great for more than system longevity. GIGABYTE equips the motherboard with high-grade, precise power-handling to support the extreme loads and heat generated by overclocking. Power trace paths, for example, are built with additional copper to handle higher than normal loads. The high-quality solid state capacitors are also rated to work at maximum efficiency for extended periods of time. Overclockers should also like that the pins in the CPU socket feature 15 Micron thick plating (conventional sockets are five microns thick) to improve connectivity and reliability.

With such overclocking potential, it's smart that GIGABYTE includes onboard tools and features to quickly reach peak performance. The voltage measurement points include VCCIO, VAXG, VDIMM, DDRVTT, PCHIO, VSA, VPP_25V, and VCORE to feed real-time power measurements to a multimeter. GIGABYTE also provides two temperature sensor headers to work with thermistor cables. Overclockers working in an open case environment should appreciate the onboard power, reset, and clear CMOS buttons.

If something with your overclock should go wrong, it's easy to figure out the problem, thanks to onboard LEDs that will light up if the CPU, memory, graphics card, or storage is malfunctioning. A debug display is present to troubleshoot other issues. There's also an SB switch, which disables the board's DualBIOS function, should it get stuck in a loop during a BIOS recovery process.

A high-performance rig is no problem for the GA-Z270X-UD5. The mainboard supports up to 64GB of system memory, and GIGABYTE has tested it with XMP profiles as fast as 4133MHz. GPU-wise, you can install up to 2-way SLI or 3-way CrossFire configurations—just like most every Z270 system—as well as single cards with two onboard GPUs and NVIDIA Quadro models designed for workstation duties.

Just about all possible storage devices are supported. The M.2 slot supports both PCIe and SATA M.2 storage, as well as all M.2 form factors (type 2242/2260/2280/22110). GIGABYTE also includes a U.2 slot, should you have a 2.5-inch Intel SSD 750 Series drive. Six 6Gbps SATA ports provide ample options for SATA SSDs and HDDs. Interestingly, two of the 6Gbps SATA ports also support SATA DOM (Disk on Module) devices, which are small flash memory modules that can serve as boot and recovery drives.

I/O connectivity on the rear panel is as impressive as the onboard storage. A Thunderbolt 3 port is the headliner, as it supports transfer speeds up to 40Gbps. There's also a USB 3.1 port, three USB 3.0 ports, and two USB 2.0 ports for peripheral expansion. GIGABYTE includes two wired NICs, an Intel i219 and Intel i211, that both work with the included cFos Speed utility to automatically prioritize network traffic.

The GA-Z270X-UD5 looks nothing like recent Ultra Durable series boards. Gone are the gold heatsinks and trim, which is a smart move because there just aren't many PC components with gold in the color scheme. The silver accents nicely match the steel shielding on the PCIe and DIMM slots. Overall, the silver accents are much more likely to go with the components in a build, such as an air cooler and aftermarket GPU heatsinks. The PCB is still dark black and will blend into the dark spaces of your case.

In terms of expansion slot layout, we like that GIGABYTE includes two slots worth of space between the top two PCIe x16 slots, as the layout gives high-powered GPUs room to breathe. A third PCIe slot is available, but it shares bandwidth with the bottom two PCIe x1 slots. Another PCIe x1 slot is located above the top PCIe x16 slot, making it a nice spot for an add-in sound card or wireless card because the PCIe x1 slot won't be blocked be a dual-slot GPU. The top PCIe x1 slot also doesn't share bandwidth with any other slots.

We tested the GA-Z270X-UD5 with an Intel Core i7-6700K, GIGABYTE's GeForce GTX 1080 Xtreme Gaming, 16GB of Corsair Vengeance LED 16GB DDR4-3200MHz, and a 480GB Patriot Hellfire SSD. In 3DMark's Fire Strike Extreme test, the system produced an overall score of 10040, a result that's propped up by the Graphics Score of 11048. The Intel Core i7-6700K was efficient in POV-Ray 3.7 with a mark of 1976.63 pixels per second. Storage speeds with Patriot's Hellfire reached sequential reads of 2598MBps and writes of 1392MBps.

Packed with a number of enthusiast features, GIGABYTE's GA-Z270X-UD5 is a good fit for anyone who plans to tweak voltages and optimize component performance. We also like the variety of storage devices it supports, as well as the onboard connectivity. In short, there's very little chance the GA-Z270X-UD5 won't support the hardware in your build—now or into the foreseeable future. ■

BY NATHAN LAKE

| Benchmark Results | GIGABYTE GA-Z270X-UD5 |
| --- | --- |
| 3DMark Fire Strike Extreme | 10040 |
| Graphics Score | 11047 |
| Physics Score | 12937 |
| PCMark 8 | |
| Creative Score | 5914 |
| SiSoftware Sandra 2016 | |
| Dhrystone AVX2 (GIPS) | 187.66 |
| Whetstone AVX (GFLOPS) | 113.31 |
| Multi-Media Integer AVX2 x32 (Mpixels/s) | 552.32 |
| Multi-Media Long-int AVX2 x16 (Mpixels/s) | 200.14 |
| Multi-Media Quad ALU x1 (Mpixels/s) | 2.23 |
| Floating B/F AVX/128 (GBps, mem bandwidth) | 35.4 |
| CrystalDiskMark 5.1.2 (MBps) | |
| Sequential Read (Q32T1) | 2598 |
| Sequential Write (Q32T1) | 1392 |
| Random 4K Read (Q32T1) | 716.5 |
| Random 4K Write (Q32T1) | 610.6 |
| POV-Ray 3.7 (Pixels/s) | 1976.63 |
| Cinebench 15 (Points) | 913 |
| Games | (2,560 x 1,440) |
| Metro: Last Light (Very High, 16xAF; SSAA off) | 105fps |
| Dying Light (High, AO On, AA On, Vsync Off) | 108fps |
| Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra) | 88.3fps |

**Specs:** Max memory: 64GB DDR4 (DDR4-2400; Max OC: DDR4-4133); Slots: 3 PCIe 3.0 x16, 3 PCIe x1; Storage: 1 M.2 (type 2242, 2260, 2280, 22110), 1 U.2, 6 6Gbps SATA; Rear I/O: 1 HDMI, 1 DisplayPort, 1 Thunderbolt 3, 1 USB 3.1 (Type-A), 3 USB 3.0, 2 USB 2.0, 2 Ethernet, 1 S/PDIF, audio I/O; Form factor: ATX; Warranty: 3 years

**Test System Specs:** Intel Core i7-6700K; GPU: GIGABYTE GeForce GTX 1080 Xtreme Gaming; Memory: Corsair Vengeance LED 16GB DDR4-3200MHz; Storage: 480GB Patriot Hellfire; OS: Windows 10 Enterprise

*"Good looks, quiet operation, a solid mounting system, and plenty of headroom for overclocks. . . ."*

**CORE FROZR L**
$49.99
MSI
us.msi.com

# MSI CORE FROZR L

MSI's FROZR technology is no stranger to enthusiasts, having been utilized in MSI GPUs for almost a decade. If the FROZR thermal design is good enough to cool off the hottest GPUs on the planet, it only makes sense to adapt the technology for a CPU cooler. Enter the CORE FROZR L. This tall air cooler features 8mm, nickel-plated copper heatpipes—just like the ones you'll find on many MSI GPU coolers. There's also a 120mm TORX fan to effectively dissipate heat while generating a minimum amount of noise.

From the outside, the CORE FROZR L looks like a lot of air coolers on the market. The 120mm TORX fan clips onto a tall array of aluminum fins that tower over the CPU socket. The four 8mm heatpipes are spaced across the fin array to efficiently disperse heat. MSI also includes two swappable covers (one silver and one black) to attractively conceal the fin array. When the system is powered on, an LED illuminates MSI's GAMING logo and red accents behind the cover.

What makes the CORE FROZR L different? To start, there aren't many air coolers that boast 8mm heatpipes within a slim fin array, nor are there a lot of 8mm heatpipe air coolers at the CORE FROZR L's $49.99 price. The 8mm heatpipes help the air cooler to dissipate up to 200 watts of heat, according to MSI. The included 120mm TORX fan is another bonus with a static air pressure up to 2.09mmH20 and a maximum air flow of 71.27cfm. The PWM controlled fan spins anywhere between 500rpm and 1,800rpm, depending on load. At 1,800rpm, MSI rates the fan for a noise level of 33.6dB(A).

The CORE FROZR L installation process is fairly simple. There's a universal backplate that mounts to the back of your motherboard. MSI also includes a universal anchor plate, which replaces the Intel- or AMD-specific bracket you typically need to attach to the heatsink. By using two thick metal plates as a mounting mechanism, MSI believes the CORE FROZR L will prevent bends to the motherboard over the long term. A thick metal strap goes over the heatsink's baseplate and screws into the universal anchor to secure the air cooler. Our biggest complaint about the CORE FROZR L installation is the excess fan cabling, which requires some cable management to conceal.

We paired the CORE FROZR L with an Intel Core i7-6700K and GIGABYTE's GA-Z270X-UD5 motherboard to test it under load. After running POV-Ray 3.7 for 10 minutes, the processor reached a maximum temperature of 61 degrees Celsius with an average temperature of 58.7 C. Next, we ran Prime95's Small FFT test for 10 minutes, and the CPU's average temperature raised to 64.8 C with a maximum of 67 C. The cooling performance is excellent for a CPU cooler in the $50 price range.

Good looks, quiet operation, a solid mounting system, and plenty of headroom for overclocks are positive attributes for any CPU cooler, let alone a $49.99 air cooler. The CORE FROZR L is absolutely a successful adaption of MSI's FROZR technology. ∎

BY NATHAN LAKE

**Specs:** Materials: Copper (base, 8mm heatpipes), aluminum (fins); Fan: 120mm PWM (500 - 1,800rpm); Cooler Dimensions: 6.1 x 3.3 x 5.5 inches (HxWxD); Socket compatibility: Intel LGA 775/115X/1366/2011(3), AMD AM2 (+)/AM3 (+)/FM1/FM2 (+)/AM4; Warranty: 1 year

**Test system specs:** Intel Core i7-6700K; Motherboard: GIGABYTE GA-Z270X-UD5; GPU: GIGABYTE GeForce GTX 1080 Xtreme Gaming; Memory: Corsair Vengeance LED 16GB DDR4-3200MHz; Storage: 480GB Patriot Hellfire; OS: Windows 10 Enterprise

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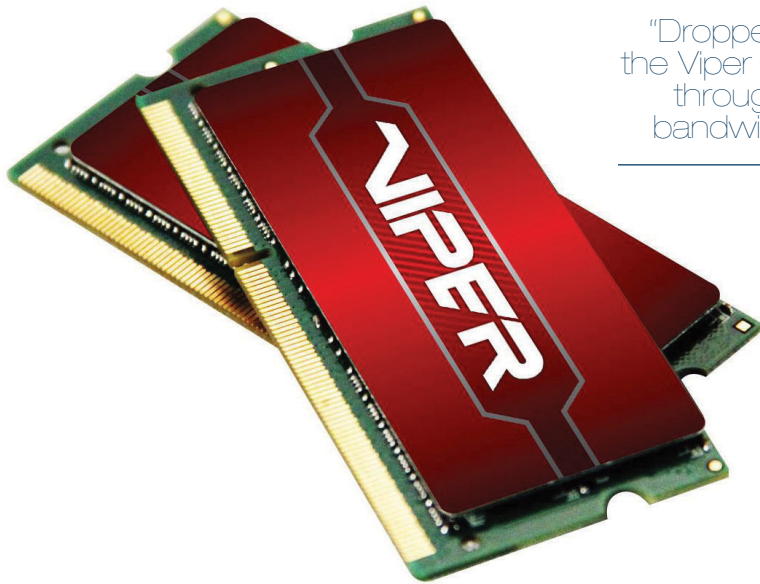
"Dropped into an Intel Skull Canyon NUC, the Viper 4 Series DDR4-2800 kit rampaged through SiSoftware Sandra's memory bandwidth tests to the tune of 30GBps."

| Benchmark Results | Patriot Viper 4 Series DDR4-2800 SO-DIMM 16GB |
| --- | --- |
| **SiSoftware Sandra 2016** | |
| Integer Memory Bandwidth B/F AVX2/256 | 30GBps |
| Float Memory Bandwidth B/F FMA/256 | 30.42GBps |
| Transactional Throughput | 25.43MTps |

# Patriot Viper 4 Series DDR4-2800 SO-DIMM 16GB

Can we all agree that it's time to stop calling SO-DIMM DRAM "laptop memory"? Despite the fact that SO-DIMMs continue to be the go-to memory for notebooks ranging from Chromebooks to DTRs, the modules have carved out a role in many other systems, particularly mini/SFF PCs, HTPCs, and even some Mini-ITX motherboards. Now that enthusiasts and manufacturers alike have recognized they can turn to SO-DIMMs to save space without sacrificing performance, there's a greater need for reliable, high-performance memory. Brand X ain't going to cut it.

Thankfully, enthusiast memory makers have recognized that need. Now that DDR4 has trickled down to mainstream systems, the usual suspects—Patriot included—have expanded their portfolios to give power users access to top-notch SO-DIMMs. This month, a 16GB kit of Patriot's Viper 4 Series SO-DIMMs slithered into our lab, ready to sink its fangs into a few benchmarks.

The kit we received contained a matched pair of 8GB DDR4-2800 SO-DIMMs, but as is typical with Patriot's families of enthusiast memory, the Viper 4 Series SO-DIMM lineup encompasses a range of speeds and capacities. Batting leadoff is a single 8GB stick of DDR4-2400, and the Viper 4 Series' cleanup hitter is a 32GB kit (2 x 16GB) of DDR4-2800. Being able to buy individual sticks of Viper 4 Series SO-DIMMs is a nice option.

Farther down the spec sheet, our test kit compares favorably with other DDR4 SO-DIMMs on the market. The memory boasts timings of 18-18-18-43, and the operating voltage is 1.2V. Patriot has been in the memory game for over three decades, so it isn't terribly surprising that the company backs the Viper 4 Series SO-DIMMs with a limited lifetime warranty.

As far as aesthetics go, if you're familiar with Patriot's Viper 4 DDR4 for desktop PCs, then the Viper 4 SO-DIMMs will be immediately recognizable. Visually, the mini modules simply took a page from their big brothers and shrunk it down to SO-DIMM size. That's fine in our book, since the Viper 4 heat spreaders are attractive without being gaudy. It's a shame, though, that most compatible systems keep their memory tucked away out of sight.

We mentioned mini PCs as a perfect candidate for enthusiast-grade SO-DIMMs, and that's just what we used to test our kit. Dropped into an Intel Skull Canyon NUC, the Viper 4 Series DDR4-2800 kit rampaged through SiSoftware Sandra's memory bandwidth tests to the tune of 30GBps. At the time of this writing, we couldn't find the kit for sale at its MSRP, but it's nonetheless a solid set of SO-DIMMs. ∎

BY VINCE COGLEY

**Viper 4 Series DDR4-2800 SO-DIMM 16GB**
$99.99
Patriot
www.patriotmemory.com

**Specs:** Capacity: 16GB (2 x 8GB); Timings: 18-18-18-43; Frequency: DDR4-2800; Voltage: 1.2V; Module dimensions: 1.19 x 2.67 x 0.17 inches (HxWxD); Unbuffered; Non-ECC; Warranty: Limited Lifetime
**Test system specs:** CPU: Intel Core i7-6770HQ; Chipset: Intel H170; GPU: Intel Iris Pro Graphics 580; Storage: Kingston RBU-SNS8152S3/256GG5 M.2 SSD

*"Despite the affordable price, there's no compromise on efficiency, reliability, or warranty."*

**ZM750-EBT**
$89.99
Zalman
www.zalman.com

# Zalman ZM750-EBT

Power users in the market for a 600 to 800 watt power supply have a tremendous number of options to choose from. At press time, there were 165 PSUs between 600 and 800 watts sold by Newegg. The sheer number of choices means that a PSU must check a lot of boxes to even be considered by enthusiasts. Zalman's ZM750-EBT meets the majority of the criteria we look for in a quality PSU. It's 80 PLUS Gold certified, is semi-modular (with only the 20+4-pin, 4+4-pin EPS, and two 6+2-pin connectors hardwired), comes with heavy-duty rail protections to keep our rig safe, and boasts a seven-year warranty.

With the ZM750-EBT, Zalman uses high-quality Rubycon capacitors that are rated to perform at temperatures up to 105 degrees Celsius. To produce an efficient, stable signal, the ZM750-EBT features an LLC converter circuit design and a DC-DC converter for the +5V and +3.3V rails. The +12V rail can support the maximum power of the PSU (750 watts) and an output load of 62.5A. Zalman also installs

a secondary protection circuit that monitors the PSU rails for overcurrent, overvoltage, undervoltage, overpower, overtemperature, and short-circuit conditions.

The PSU's modular cables are the flat, black ribbon style found on many PSUs these days. Zalman uses red connectors for the modular PCIe cables, which is handy for identification, but generally speaking, doesn't look great inside a build. We'd have preferred black connectors, like what's found on the rest of the cables, or at least, black connectors on the plugs going into the GPU. Cable lengths are decently long for the modular cables, but those with full towers might find the hardwired main power cable (19.69 inches long) and EPS cable (25.6 inches long) too short to route behind a motherboard tray. Overall, connector selection is respectable with four PCIe 6+2-pin, eight SATA, and six Molex.

A lot of modern cases come with PSU shrouds that conceal the unit entirely, but if your case doesn't, Zalman has you covered. The fan intake, for instance,

includes an attractive, gold brushed aluminum trim and a decorative fan grill. The rest of the PSU features a smooth black finish.

The ZM750-EBT fared well in our load tests. We installed it into a system with an Intel Core i7-6700K, GIGABYTE GeForce GTX 1080 Xtreme Gaming, and 16GB of Corsair Vengeance LED DDR4-3200MHz. Then, we ran Prime95's In-Place mode and Unigine's Heaven 4.0 benchmark to create demanding loads on the CPU and GPU. At peak power, the ZM750-EBT reached 345 watts and a power factor of .984. In general, power factor results were first-rate and routinely between .980 and .995.

Zalman aggressively prices the ZM750-EBT at $89.99, while many comparable 750 watt power supplies are well over $100. Despite the affordable price, there's no compromise on efficiency, reliability, or warranty. ∎

BY NATHAN LAKE

**Specs:** Maximum wattage (continuous): 650W; 12V rail: 1 62.5A; +5V max: 22A; +3.3V max: 22A; Efficiency rating (advertised): 80 PLUS Gold; Fan: 135mm; Connectors: 1 x 20+4-pin ATX, 1 x 4+4-pin EPS12V, 4 x 6+2-pin PCIe, 8 x SATA, 6 x Molex, 1 x FDD; Warranty: 7 years

**Test System Specs:** Processor: Intel Core i7-6700K; Motherboard: GIGABYTE GA-Z270X-UD5; GPU: GIGABYTE GeForce GTX 1080 Xtreme Gaming; Memory: Corsair Vengeance LED 16GB DDR4-3200MHz; Storage: 480GB Patriot Hellfire; OS: Windows 10 Enterprise

**Eiswand 360 CPU**
$295
Alphacool
www.alphacool.com

*"Power users and overclockers in need of some serious cooling . . . should consider the Eiswand 360 CPU to drive extreme performance."*

# Alphacool Eiswand 360 CPU

Back when cases weren't regularly designed with liquid-cooling in mind, enthusiasts would sometimes bolt radiators and other liquid cooling parts to a case's exterior. Typically, externally-mounted components didn't look great, but the design did give you the freedom to use thick, long radiators that wouldn't fit inside your case for high performance cooling and overclocks. The internal space savings was also helpful if your build used extra-large components, such as monstrous dual GPU cards.

The small form factor movement among enthusiasts reintroduces many of the liquid-cooling space constraints we faced in the past. At the same time, power users don't want to ruin the slim, sleek look of a SFF build by bolting anything to the outside of the case. Alphacool's Eiswand 360 CPU is an elegant workaround, as it features an external AIO liquid cooling tower with a 360mm copper radiator, six 120mm fans in a push-pull configuration, two pumps, and a reservoir in an elegant black aluminum frame.

The Eiswand 360 CPU is a complete cooling kit. Alphacool supplies its slim NexXxos XP3 Light CPU water block, black tubing, black fittings, liquid coolant, and an external power supply.

Alphacool also includes two quick disconnect fittings, so you can easily expand the system with other liquid-cooling components, such as Alphacool's Eiswolf GPX-Pro AIO—a GPU cooler designed with the same quick disconnects.

Alphacool uses high-quality parts with the Eiswand kit. The NexXos XP3 Light water block, for example, features a cross-slotted structure with backflow channels to maximize flow rate and recirculation. There are four compression fittings with an 11/8mm inner thread (G1/4 outer thread) to perfectly fit the 11/8mm tubing. The Eiswand also comes with four long springs that slide over the tubing to prevent kinking.

The external unit features a NexXxos XT45 360, a full copper radiator that's 1.8-inches thick. The integrated reservoir sits atop the Eiswand, and Alphacool builds in a fill port with a window, so you can easily add coolant. To ensure constant operation, the Eiswand comes with redundant DC-LT 2600 low noise pumps. The external frame's base lights up blue during operation. You can turn off the LEDs by connecting the included silent adapter, which also drops fan speed from 1,100rpm to 700rpm.

Installing the Eiswand 360 CPU is a little more complex than a closed-loop CPU cooler, as you must cut the tubing, install the fittings and quick disconnects, and fill the loop. But as long as you have a convenient way to route the tubing outside your case, the process is much easier than designing the custom loop inside a case.

The Eiswand 360 CPU's temperatures under load were similar to, but a few degrees Celsius lower, than the company's Eisbaer 360 (an internal AIO CPU cooler). In Prime95's Small FFT torture test, Intel's Core i7-6700K maxed out at 75 C with an average temperature of 70 C. When stress testing with POV-Ray 3.7, temperatures dropped to an average of 60 C with a maximum of 64 C.

Alphacool designs the Eiswand 360 CPU so that you can proudly display it next to your system. But the included tubing is also long enough that you could put the unit on the floor, if you're short on desk space or just want to avoid extra clutter. Power users and overclockers in need of some serious cooling—but lacking internal case space to accomplish their goals—should consider the Eiswand 360 CPU to drive extreme performance. ∎

BY NATHAN LAKE

**Specs:** Materials: copper (waterblock and radiator); Socket compatibility: Intel LGA 2011(3)/1366/115X/775/604/771, AMD FM2(+)/FM1/AM3(+)/AM2(+)/939/940/754/G34/C32; Pump: 2,600rpm (2,000rpm with silent adapter), 7-13.5V; Fans: 6 120mm Alphacool Eiswind fans (1,100 rpm or 700rpm with silent adapter); Unit dimensions: 21 x 8.3 x 5.9; Warranty: 2 years

**Test System Specs:** Processor: Intel Core i7-6700K; Motherboard: GIGABYTE GA-Z270X-Ultra Gaming; GPU: GIGABYTE GeForce GTX 1080 Xtreme Gaming; Memory: Corsair Vengeance LED 32GB DDR4-3,200MHz; Storage: 480GB Patriot Hellfire; OS: Windows 10 Enterprise

*". . . one of the coolest little SFF cases we've seen to date . . . ."*

# ENERMAX STEELWING

Last month we reviewed a really nice small form factor power supply from ENERMAX called the Revolution SFX 650W. Fully modular and less than four inches deep, the SFX did a nice job with our benchmarks and would be a smart addition to any Mini-ITX or MicroATX build. Lo and behold, a month later ENERMAX sent us one of the coolest little SFF cases we've seen to date, the STEELWING.

The STEELWING gets its name from the seven wing-shaped vertical aluminum plates that are stacked across the front of the system right along the front panel opening, which is covered in mesh. The case is constructed entirely of anodized aluminum (ALUMINUMWING?), the only exception being its tempered glass left-side panel, and ENERMAX says that this allows it to dissipate heat at three times the rate of a similar case built from steel.

To that end, ENERMAX pre-installs a 120mm LED fan behind the vent-and-mesh front panel for pulling in cool outside air, and built in a mesh panel on the top, as well, which allows ambient heat to rise up and out. In addition, the case will support installation of a 120mm radiator behind the front-panel fan, which means that you can pack in an all-in-one CPU cooler if you like. Or, if you are skilled and adventurous, you can even build in a custom cooling loop; ENERMAX's promo video for the case shows a STEELWING rig with a complete loop inside, and it looks quite good.

One item to note; the bracket that holds the front-panel fan and, potentially, a 120mm radiator, is also one of two available 3.5-inch drive mounts in the case. There is a dedicated 2.5-inch mount on top of the rear 3.5-inch mounting bracket. You can remove the rear bracket if you don't need it (say, for example, you are running an M.2 SSD instead), and that will free up some space along the bottom. Also, installing a radiator or 3.5-inch drive behind the front-panel fan will limit graphics card size, but there are some excellent small form factor graphics cards on the market today, so this shouldn't present too great an obstacle.

This is truly a small form factor case, not just a smallish mid-tower like some that we've seen. It will accept an up to 11.4-inch graphics card (again, without a radiator or drive behind the front fan), and of course you can install normal-sized processors and memory, but everything else needs to be practically Lilliputian in order to make this work. The end result, however, is an extremely compact PC that is also light enough to lug around easily (great for LAN parties) and one that looks great all the while. The case comes in two color variations: silver with a green right-side panel and a green LED fan behind the front panel, or black with a red side panel and fan. Regardless of which color you choose, this case punches well above its weight. ∎

BY CHRIS TRUMBLE

**STEELWING**
$169
ENERMAX
enermaxusa.com

**Specs:** Dimensions: 11.8 x 6.9 x 15.2 inches (HxWxD); Materials: Aluminum, tempered glass; Motherboard support: Mini-ITX, mATX; Drive bays: 1 3.5-inch/2 2.5-inch internal, 1 x 3.5-inch internal; Fans (included): 1 x 120mm LED front; Ports: 2 x USB 3.0, audio I/O

www.booksmania.net

**Radeon RX 480 G1
Gaming 8G**
$259.99
GIGABYTE
www.gigabyte.us

*". . . a heck of a good deal."*

# GIGABYTE Radeon RX 480 G1 Gaming 8G

GIGABYTE recently sent us its RX 480 G1 Gaming, and we decided to repay the kindness by pummeling the unsuspecting piece of silicon with our suite of benchmarks. But before we get to the performance numbers achieved by GIGABYTE's take on the flagship GPU in the Polaris lineup, let's take a closer look at the extras you get when you choose this model.

This card is strapped to GIGABYTE's WINDFORCE 2X cooler, which consists of a matte black plastic heatsink shroud, a pair of 90mm fans, and an aluminum heatsink threaded with a trio of copper composite heatpipes, which are built from a hollow pipe made of sintered copper powder wrapped with another layer of copper with grooved inner walls. As liquid between the sintered and grooved copper layers heats up, it vaporizes and travels to the cool portion of the pipes, cools and condenses, and then cycles back to the hot portion of the pipe. GIGABYTE's unique heatpipes boost cooling capacity by 29%.

The fans on this heatsink are also atypical; they remain motionless when the card is idle, but spin up in opposite directions to create a more aggressive blast of cool air when under load. The GIGABYTE and Fan Stop logos are backlit with LEDs, which you can personalize using GIGABYTE's Xtreme Gaming Engine utility.

The brushed aluminum black backplate is another feature that's both attractive and functional, acting as another avenue for heat to escape from the GPU, VRM, and VRAM chips. The backplate also makes the card significantly more rigid.

The Radeon RX 480's Polaris 10 GPU features 36 compute units, 2,304 stream processors, 144 texture units, 32 ROPs, and the VRAM runs with a 256-bit memory bus. This variant comes with 8GB of GDDR5 memory clocked at 2,000MHz, but GIGABYTE offers a G1 Gaming version with 4GB as well. AMD's reference design calls for base and boost clocks set to 1,120MHz and 1,266MHz, but the GIGABYTE card ships with a slight overclock, up to 1,290MHz.

The RX 480 G1 Gaming has a 150-watt TDP and a single 8-pin PCIe power port delivers all the juice this card needs. On the back of the card, you'll find one HDMI, one DVI, and three DP ports. If a VR HMD is something you own or plan to buy, make sure you have a monitor with a DP or DVI interface.

At its default settings, this card delivers good framerates in the games we tested, but we did notice some minor thermal throttling under load. If you really want to push the pedal down, the WINDFORCE 2X cooler can handle it, and AMD's driver-based WattMan utility or GIGABYTE's own Xtreme Gaming Engine are two ways to squeeze a few more drops of power from this card. Even better, this card was selling for $235 as we went to press, making it a heck of a good deal. ∎

BY ANDREW LEIBMAN

| Specs & Scores | GIGABYTE RX 480 G1 Gaming 8G |
|---|---|
| Core clock | 1,290MHz |
| Memory clock | 2,000MHz |
| Memory interface | 256-bit |
| Memory | 8GB GDDR5 |
| **3DMark Professional (Fire Strike Extreme)** | **5,384** |
| Graphics Score | 5,535 |
| Physics Score | 21,207 |
| **Games** | **(1,920 x 1,080)** |
| Shadow Of Mordor (Vsync Off, Ultra, DoF, OIT, Tess) | 91.64fps |
| Metro: Last Light (DX11, V High, 16XAF, V High Tess.) | 80.67fps |
| Dying Light (High, AO On, AA On, Vsync Off) | 98.23fps |
| Witcher 3: Wild Hunt (Vsync off, Unl. fps, Ultra) | 67.63fps |
|  | **(2,560 x 1,440)** |
| Shadow Of Mordor (Vsync Off, Ultra, DoF, OIT, Tess) | 64.98fps |
| Metro: Last Light (DX11, V High, 16XAF, V High Tess.) | 51.67fps |
| Dying Light (High, AO On, AA On, Vsync Off) | 66.22fps |
| Witcher 3: Wild Hunt (Vsync off, Unl. fps, Ultra) | 46.1fps |
|  | **(3,840 x 2,160)** |
| Shadow Of Mordor (Vsync Off, Ultra, DoF, OIT, Tess) | 35.05fps |
| Metro: Last Light (DX11, V High, 16XAF, V High Tess.) | 26fps |
| Dying Light (High, AO On, AA On, Vsync Off) | 34.38fps |
| Witcher 3: Wild Hunt (Vsync off, Unl. fps, Ultra) | 24.74fps |

**Test System Specs:** Processor: Intel Core i7-6950X; Motherboard: GIGABYTE GA-X99-Ultra Gaming; Memory: 16GB HyperX Predator DDR4-3000; Storage: 240GB OCZ Vertex 3 MAX IOPS SSD; OS: Windows 10 Enterprise

# State-Of-The-Art Standards

## WiGig



Networking standards are often developed and defined years ahead of mainstream adoption. The process allows all involved parties, from the IEEE (Institute of Electrical and Electronics Engineers) to router and device makers, to collaborate on the foundations of the standard. Some standards, such as 802.11n and 802.11ac, gain quick acceptance in devices and our home networks. Other times, the architecture is designed with an eye to the future. Instead of riding the fast track, these poor protocols must wait for the development of a practical application.

WiGig, also known as 802.11ad, is a wireless networking standard developed in 2009 that's always offered promise with huge bandwidth and low latency. Up until recently, the standard's downsides, such as the inability to penetrate walls and short effective range (up to 33 feet), have severally limited its use. But there's new hope for WiGig, thanks to potential applications in VR and AR headsets, wireless docking stations, streaming devices, and wireless displays.

### Why WiGig?

The Wireless Gigabit Alliance was incorporated in April 2009 to develop wireless transmissions in the millimeter wave frequency band, and WiGig 1.0 was published in February 2010. A proposal based on WiGig 1.0 was sent to the IEEE 802.11ad task group, which was working on a way to deliver high throughput over the 60GHz frequency. The proposal was approved in May 2010 and included backward compatibility with other IEEE 802.11 protocols. The IEE 802.11ad task group and Wireless Gigabit Alliance worked together to evolve the standard into the official 802.11ad protocol released in December 2012.

Unlike previous 802.11 wireless standards, WiGig operates in the 60GHz band to deliver much greater bandwidth and lower latency than what's possible over the 2.4GHz or 5GHz spectrum—we're talking data rates up to 8Gbps over a single band. 802.11ac, by comparison, tops out at a theoretical rate of 4.5Gbps with current consumer routers delivering maximum theoretical speeds of only 2Gbps. The move to the 60GHz also skirts interference that you might run into with nearby devices communicating via the 2.4GHz or 5GHz spectrum.

"The problems Wi-Fi faces today are interference and capacity," says Philip Solis, research director at ABI Research. "Some houses have a family of several people, a few of whom are streaming 1080—or even 4K video, now—and eventually, video quality will reach 4K HDR and 8K resolution." Besides the bandwidth hogging video

WiGig products bearing the Wi-Fi CERTIFIED WiGig logo meet interoperability and security standards established by the Wi-Fi Alliance.

streams, modern dwellings are likely have a PC or tablet accessing the Wi-Fi, as well as a few smartphones running apps that consistently ping the router.

"The solution [to the congestion] will be to divide traffic among the smaller 2.4GHz band and larger 5GHz band, but also the 60GHz band," says Solis. Shifting video streaming to WiGig, in particular, could prove an easy way to offload traffic from the 2.4GHz and 5GHz bands. WiGig is merely a way to augment existing wireless networks, as its relatively short range prevents the standard from replacing many of the current applications of the 2.4GHz and 5GHz spectrum.

## Where Does WiGig Fit?

As more home electronics connect to the Internet via Wi-Fi, there could be a very real need for the 60GHz spectrum to clear up congestion and fix capacity issues. The Wi-Fi Alliance projects that by 2021 more than 32 billion Wi-Fi devices will ship worldwide, up from a projected 2.8 billion in 2016. Not every device will require bandwidth or latency that rivals a

wired connection, but for those that do, WiGig and the 60GHz band may become the wireless spectrum of choice.

"The fact that the 60GHz band is limited by obstructions, such as walls,

is actually a good thing for it," says Solis, because it will be relatively easy to prevent congestion that's so common in the 2.4GHz band. Many of the current use cases for WiGig are designed around point-to-point connections. Untethering VR headsets is s prime point-to-point application, as it would be extremely helpful to remove cords and free people to use the VR headset wherever they want to.

WiGig's low latency is huge for VR headsets, as mismatches in motion and visual information can cause dizziness and produce an overall poor user experience. Leading VR headsets, such as the Oculus Rift and HTC Vive, for instance, utilize several different techniques in the software and hardware to keep latency below 20ms. It's expected that any WiGig-certified VR hardware would be well under the recommended 20ms round-trip latency.

Wireless PC docks are another exciting point-to-point WiGig option. Initial versions of WiGig docking stations required specific laptop placement to achieve the connection, but that's not the case with newer WiGig chipsets. Monitor makers might even start to build wireless



WiGig is an option to untether the VR headset from the PC.

docks into the display. "You will just place your portable PC on your workstation and it will wireless charge and connect to the dock via WiGig," says Solis. "All the connections to the monitors, peripherals via Bluetooth, and Internet via Wi-Fi or Ethernet will occur between the dock and the peripherals and access point." Wireless charging will need to advance with WiGig before we can eliminate the power cord.

WiGig access points could be a huge boost to home theater rooms, where people typically consume the most bandwidth. In this configuration, you'd likely need to run an Ethernet cable or use powerline networking to provide the best possible connection. Wireless repeaters, which receive and amplify a wireless signal, tend to introduce lag would defeat WiGig's low-latency benefit.

Some WiGig-enabled gadgets are expected to support dynamic session transfer, so your router and connected electronics could switch among spectrums based on the most demanding load. Dynamic session transfer would require devices to feature tri-band radios that communicate over the 2.4GHz, 5GHz, and 60GHz bands. Load balancing is an ideal way to make sure that every PC and



Several companies have released WiGig wireless docks.

gadget receives the necessary bandwidth to get the job done. Assuming all devices are in range, your HDTV could reserve the 60GHz spectrum for streaming, while the 5GHz band, for example, is free to serve up data to the PCs in your house.

The 2.4GHz band could be the pathway to sync up and provide bandwidth-light Wi-Fi to mobile devices.

**Ultra-Wide Wireless**

The high transmission rates of WiGig are possible thanks to ultra-wide channels available in the 60GHz spectrum. "2.4GHz can be used for longer range with 20MHz channels, and 5GHz can be used for more bandwidth-heavy applications that still need whole-home coverage with 40MHz channels in 802.11n, 80MHz channels in 802.11ac Wave 1, and 160GHz channels in 802.11ac Wave 2," says Solis. "60GHz will be used by 802.11ad, or WiGig, with 2GHz channels."

Specifically, the WiGig standard divides the 60GHz spectrum into 2.16GHz channels. For reference, the 2.16GHz channels are 50 times wider than the largest channels available in 802.11n and 10 times wider than channels in recent 802.11ac devices. Globally, not every channel in the 60GHz range is available, but here in the United States, we should have no problems. The FCC has reserved the



Tri-band wireless NICs might feature three wireless radios with a 2.4GHz band, a 5GHz band, and a 60GHz band.

Intel's RealSense technology can combine elements of VR and AR into a single virtual world.



TP-Link's Talon AD7200 supports WiGig at up to 4.6Gbps using Qualcomm's latest wireless chipsets.

with the 60GHz spectrum requires some creative thinking to boost transmission power and reception quality.

To start, it's expected that most WiGig devices will use high-gain, directional antennas to compensate for 60GHz propagation losses. Using high-gain antennas with the 2.4GHz band isn't always advisable in environments with crowded channels, such as an apartment complex, as increasing base station power can degrade capacity and signal quality to everyone nearby. But WiGig's inability to pass through walls negates the problems we often see with longer-range wireless spectrums.

WiGig devices are also expected to use beamforming techniques, which use signal-processing technology to transmit and receive signals in a particular direction, rather than utilizing a 360-degree signal. The directional communication maximizes link performance and signal efficiency, which helps to overcome propagation losses. Beamforming also reduces interference, because there's less contention with other wireless communications. If implemented correctly, WiGig could allow for multiple WiGig connections in the same vicinity.

### Display Extension

The Wi-Fi Alliance developed a technical WiGig specification for display protocols to optimize the transmission of audio and video. The WiGig Display Extension uses PALs (protocol adaption layers) to support HDMI and DisplayPort standards, as well as the HDCP schemes that protect digital content. There are also input/output PALs to support USB peripherals, SD cards, and the PCIe bus. The WiGig Display Extension capabilities make it possible to use WiGig for wireless docks and VR headsets.

### Where To Find WiGig Now

Wireless docks were some of the first WiGig products to reach consumers. Dell, Lenovo, and HP have all released WiGig wireless docks that support

57GHz to 71GHz spectrum for WiGig and other unlicensed uses.

### Overcoming Poor Propagation

At a range of only 3.2 feet, free path loss in the 60GHz range is estimated to be 68dB, which is 21.6dB worse than what we typically experience with the 5GHz band. As we mentioned, any obstacles, including walls, human bodies, and furniture can also impact signal quality with losses up to 30dB. Signal loss

Devices and routers can use beamforming to direct wireless signals where they need to go, rather than in all directions. *(Image courtesy of D-Link)*

dual displays, as well as the wireless transfer of USB and Internet data. Unfortunately, the initial WiGig docks appear to have a proprietary design and will only work with a select number of PCs made by same company. For improved device support, some WiGig docks also include a USB Type-C port that supports the same connectivity over a single wire. The Toshiba WiGig Dock, for example, is a no-compromise WiGig dock with USB Type-C ports for wired connectivity.

In October of 2016, the Wi-Fi Alliance created a certification program that ensures devices meet strict WiGig standards for security and interoperability. Titled Wi-Fi CERTIFIED WiGig, the list as of press time is fairly short with only five products, but more are expected to come throughout 2017. "Wi-Fi Alliance certification has a strong history of accelerating broad technology adoption across the industry, and we expect 2017 to be a breakout year for WiGig on the heels of Wi-Fi CERTIFIED program availability," says Solis.

Intel's Tri-Band Wireless-AC 18265 was one of first products to meet the Wi-Fi CERTIFIED WiGig standard. The M.2 module is designed for mobile clients, such as portable laptops, tablets, and convertible notebooks. For WiGig connectivity, the Tri-Band Wireless AC 18265 supports connectivity for two 1080p displays using the WiGig Display Extension. The module also supports the WiGig Serial Extension for speedy USB 3.0 data transfer. When not in range of a WiGig connection, the Tri-Band Wireless AC 18265 can connect over 802.11ac at up to 867Mbps.

Qualcomm's QCA9500 is one of the first 802.11ad-compatible chipsets to be Wi-Fi CERTIFIED WiGig. TP-LINK utilizes Qualcomm's chipsets in its Talon AD7200 router that supports WiGig at up to 4.6Gbps, as well as the 5GHz band up 1,733Mbps and the 2.4GHz band up to 800Mbps. The Talon AD7200 was the first consumer router on the market to support 802.11ad. And although we have yet to see an 802.11ad USB or add-in-card adapter from TP-LINK, there are a few laptops on the market with built-in 802.11ad

capabilities, including select configurations of Dell's Latitude 14 7000 lineup.

## What's Next For WiGig

Freeing VR and AR devices from wires appears to be the next big step for WiGig. Intel's Project Alloy, for example, is an open VR and AR platform that combines WiGig with an Intel suite of sensing and computing technologies. Intel provides open APIs and development kits to partners, such as HTC, Oculus, and Razer, many of whom are expected to come out with products in 2017.

At this year's CES, Intel showed off a Project Alloy prototype wireless headset with the company's RealSense technology, which is a depth sensor that can create a representation of the physical world in the virtual world. Intel calls the combined VR and AR environment "merged reality." RealSense integration can help you to avoid running into real life objects when roaming around in the virtual world, and the technology has also been used to scan real objects in 3D, allowing them to be manipulated in digital form.

WiGig might also come into play with upcoming self-organizing mesh networks where each connection is categorized by use case and switched over to a connection that's ideal for the job. Self-organizing mesh networks are more likely to be seen in the business space, but there are several new consumer options designed to provide seamless Wi-Fi connectivity over large households. The Orbi Home WiFi System, for instance, optimizes your connection over two 802.11ac bands and one 802.11n band.

## Building Momentum

With a few emerging real-life applications for WiGig, now is the time for hardware and device manufacturers to start including 802.11ad radios in PCs, network adapters, and smartphones. Once the technology is built into devices, network hardware support of WiGig should follow. Failing popular device support, it's possible that WiGig will find a home as a point-to-point wireless option for displays, VR headsets, and wireless docks. ∎

# MRM™
## MAD READER MOD

# Project Wifey

Last time we checked in on Travis "The Raw View" Jacques (who has recently begun going by "Travis Fader"), we were marveling at his first-ever "Mad Reader Mod" winner, Project Red Gotham in the June 2016 issue. Project Red Gotham was very impressive, especially from a guy who says he just started building PCs in 2013, but Fader wasn't done yet. He mentioned at the end of our coverage of his red small form factor mod that he had begun work on a new rig for his wife Rachel, who wanted a PC to game on. (Fader says she enjoys adventure games like Middle-Earth: Shadow of Mordor.) Thus was born this month's MRM winner, Project Wifey.

## Happy Wife, Happy Life

When Rachel asked him for a gaming rig of her own, he went to work. "I just like creating," Fader says. "For this build, I wanted it to be shiny. I was thinking of a black dress with silver jewelry." He tells us he was inspired to try Project Wifey's very cool textured paint after having seen it on a few motorcycles; he says getting the paint right accounted for the bulk of the 40 to 60 hours he spent on the build. "The paint job took a lot of trial and error to get it the way I wanted it," he says.

Fader used silver, black, and glitter clear on Project Wifey's paint job. "It is hard to pick up the glitter effect in videos and photos, but it really makes it pop in person with this rainbow effect," he says. "The MSI Titanium motherboard is one of the only silver motherboards on the market and really helped out with the look, along with the silver Airplex radiators from Aquacomputer."

Aside from the paint, Fader did a few minor mods to his Corsair Carbide Clear 600C, including cutting a fill port hole on the top, and drilling a few holes needed to mount the system's radiators. He also spent quite a bit of time planning and building Project Wifey's cooling loop. "I wanted the loop to be very symmetrical," Fader says, "So I spent a lot of time planning the loop out and I used acrylic pieces here and there to support it and keep it from sagging."

## Marital (& Gaming) Bliss

In addition to its Corsair Carbide Clear 600C case (which sports an inverted motherboard tray, by the way), Project Wifey consists of an Intel Core i7-6700K, an MSI Z170A XPOWER GAMING TITANIUM EDITION motherboard, 16GB of Corsair Vengeance LPX DDR4 memory, dual EVGA GeForce GTX 970 FTW graphics cards configured in SLI, a Corsair RM850x power supply, and three 500GB solid-state drives. The cooling loop is built from the aforementioned Aquacomputer Airplex radiators, Fractal Design Venturi fans, EKWB waterblocks, Barrow fittings, and dual XSPC pumps. Fader rounded out the build with IceModz custom sleeved power cables.

Fader would like to thank his sponsors: Play-Asia.com, EVGA, Corsair, Titan Rig, and IceModz.

He tells us that he's already begun work on his next project, which is an update of Project Red Gotham, which Fader is still using as his personal daily PC. "I want to go bigger! That's all I can really say about it right now," he says.

You can check out a video of the whole process of creating Project Wifey on Fader's YouTube channel at www.youtube.com/therawview. ■
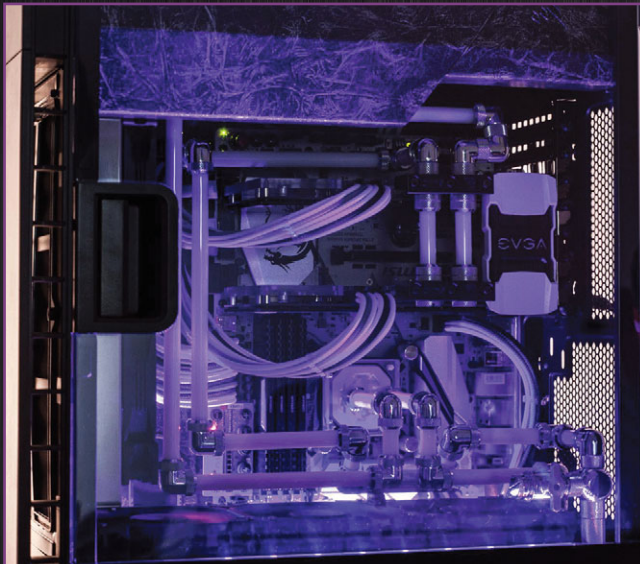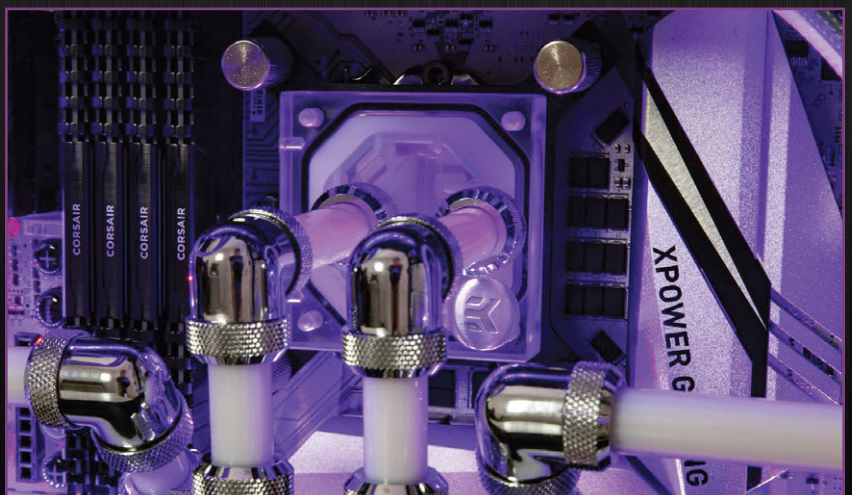
## Sleepless In Portland
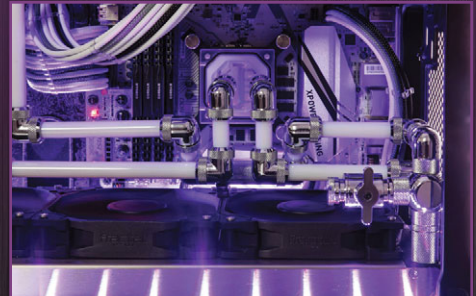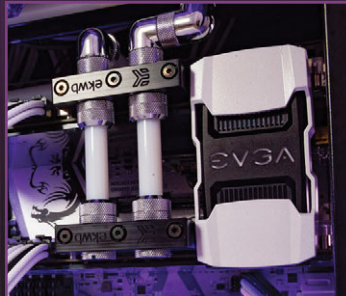# It's A Gamer's Paradise
# At PDXLAN 29



There are a lot of major LAN parties hosted all over the world, and we've attended hundreds of them, but PDXLAN is the one that we keep coming back to like a bad habit. Well, we'd hardly call four days of nearly-nonstop gaming and comradery, an avalanche of amazing PC component prizes, and tens of thousands of dollars raised for charity a bad habit. Although we changed up our presence a little bit, PDXLAN 29 was the same great event, for fellow sponsors and attendees alike.

## VR To The Masses

We recently got our hands (and faces) on a VR rig, and we thought PDXLAN would be a great place to bring it out and get some feedback on Arizona Sunshine, one of the VR games we were in the process of reviewing. (You can read our full take on the VR zombie slayer in this issue). Although there was a steep learning curve when it comes to getting around and reloading weapons, we heard plenty of good things from the people who took the game for a spin. By the end of the weekend, we were in the top 250 on the leaderboard and people were lining up to give the game's Horde Mode another go.

# Not Your Typical LAN Party

At PDXLAN, it's not uncommon to look up bleary-eyed from your screen to see something unexpected happening. Yes, that's a Doctor Mario competition happening in all its 8-bit glory. There was also a how-far-can-you-get-on-a-single-life in Super Mario Brothers contest, a Nerf dart headshot contest, and a build-a-graphics-card-out-of-duct-tape contest, the results of which were very impressive. And the prizes were graphics cards and some seriously powerful PC components.







A decent number of PDXLAN attendees walk away from the LAN party with more than just some new friends and a couple dozen more hours of play time in their favorite games. This guy was clearly enamored with the Rosewill GUNGNIR he won at our raffle.
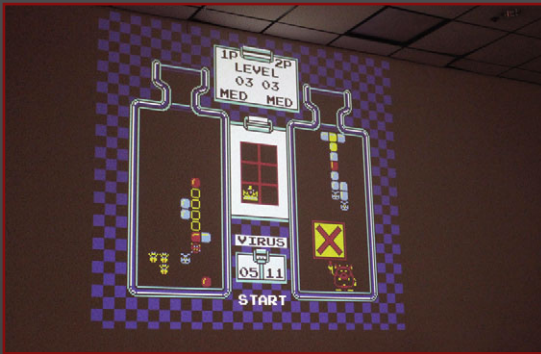
A laptop probably isn't the first thing that comes to mind when you think of a LAN rig, but this little gem has SLI, a mechanical keyboard, and a slick color-shift paint job applied by our friends over at XOTIC PC. The photo hardly does the lappy's red-orange-yellow sheen justice.

"You just won a Rosewill RGH-3300 headset!" Given his expression, we think he likes the sound of that.

# Mods, Mods, Everywhere Mods

This wouldn't be a proper PDXLAN recap article without a heavy dose of mod talk, and this event gave us lots to talk about. We had 14 mods to choose from in our mod contest, and although the following four mods didn't make the top five, we did see lots of potential. We'll be keeping an eye out for what these guys do in the future.



Brian "Dr. Modalot" Scott brought his console/PC Frankenbuild to Portland. He's got front-panel controller ports installed for Super Nintendo and PlayStation, there's an NES light gun bolted to the side panel that lets you power the PC on and off using the trigger, and yes, those are real bullet holes, courtesy of a 9mm pistol.



We've seen a lot of modded Thermaltake Core P5s, but this one, with its dual-loop liquid-cooling system, wacky hardline tubing job, and edge-lit window with a CNC-cut dragon emblem was a truly impressive sight to behold.
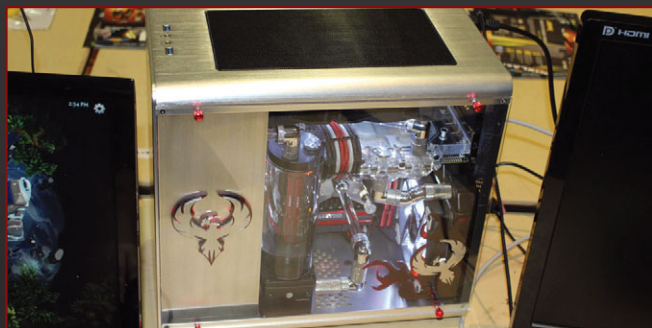




Will Schmidt's small but powerful phoenix-themed mod was a work in progress, but we were impressed with the intricate liquid-cooling setup that seems to consist solely of fittings and extensions, as well as the brushed aluminum and backlit-Plexiglas bird design. We're really looking forward to seeing Will finish out this mod in the near future.

Dante Mutti told us that he won this Fractal Design case last year, and he was determined to mod it and bring his creation back to his next event. We love the circuit design vinyl applique, custom window, and ultra-clean interior. He's also got separate SSDs for his Steam and Origin games; you know they fight when they're on the same logical partition.

# *CPU* Magazine's Mod Contest

As you can see, the competition at this event's mod contest was typically fierce for our finalists, and each one stands on its own as a prime example of a PC as a stunning work of art. But there can be only one winner, and you'll have to wait until next month to see who scored the coveted "Mad Reader Mod" slot. Until then, here's a look at the top five.

Jason Pierce brought his impressive Voltron mod, and we can't think of a better case to base a Voltron mod on than Cougar's Panzer MAX. There are a lot of little details about this mod that we just love, from the custom windowed PSU shroud to the mecha-lion front panel.
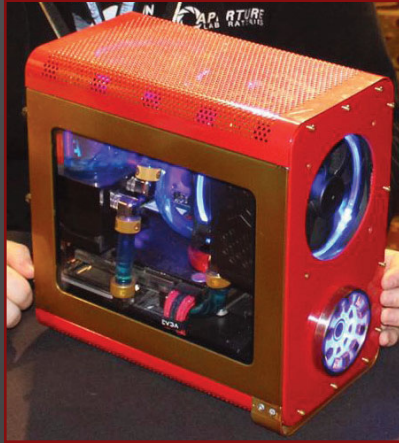
This wasn't the first time we've seen Jack "Dakotah" Bronk's Iron Man-themed mod, built in an itty-bitty EVGA Hadron, but we never get tired of seeing the impressively clean interior and arc-reactor-equipped custom front panel.
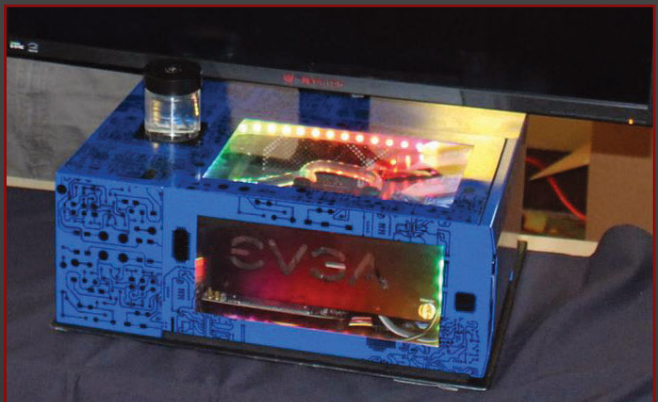
Scott McClain took the NCASE M1, the original crowdfunded mini PC case, and decided that it was just a little too small. So he embiggened it using plastic panels and bits of a second NCASE M1. The built-in monitor stand makes this the perfect LAN party system.

We've been closely following Jon "PennyWise" Hansz's progress on FrostByte for the last several months, and the final result is truly a sight to behold. The hand-painted Magic Sculpt dragon took dozens of hours just to paint. We'd say the end result was well worth the effort. Bravo, Jon!

Jeff Colia is the only one of our finalists to submit a scratch build, and you wouldn't know it at first glance. This grey and green beauty features a smart-looking hardline tubing loop, and a unique LED system that emits just the right amount of glow.

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PAX South 2017

# Remember The River Walk

On January 27 through 29, *CPU* headed to the Henry B. Gonzalez Convention Center in lovely San Antonio, Texas for the third annual PAX (Penny Arcade Expo) South event. We've been exhibitors at all three PAX South events, and while the event may not quite match the attendee and exhibitor numbers generated by PAX Prime and PAX East, it's a vibrant show that includes a cool expo, a nice-sized BYOC LAN, and all of the keynote and panel goodness that has helped to make PAX a household name among gamers across the U.S. and beyond.



If you've ever been to a PAX event on day one, you'll recognize the line to get in . . . .



As always, the PAX lounge area and its beanbag chairs were a popular place to rest tired feet.

# *CPU* In Full Effect

If it's PAX, there is probably a *CPU* booth nearby, and PAX South 2017 was no exception. We were on the expo floor chatting up attendees, talking about the mag, and giving away excellent prizes!

Signing up for our prize raffles. Next time you're at PAX, make sure you stop by and say hi.

Waiting eagerly for a raffle drawing.

We gave away mice, keyboards, and headsets from Patriot's Viper series, as well as from Rosewill. We also sent several PAX attendees home as proud (and comfortable) owners of their very own brand-new DXRacer gaming chairs!

## Cosplay

PAX events are well-known for attracting lots of cosplay (costume play) enthusiasts, and we didn't have to look to far to find quite a few at PAX South 2017, both in and outside of the venue.




## Nintendo Shows Off The Switch

PAX events are a great way for game companies to show off their new and upcoming wares to members of their target audience. Nintendo pulled out all the stops at PAX South to give fans an early look at the Nintendo Switch and several upcoming games.

# BYOC, Mods & More

No PAX would be complete without a BYOC LAN and its accompanying PC freeplay area. And, as you can probably guess, while we were in the BYOC we found a couple pretty cool rigs, as well, including one by Hassan Alaw, who has competed in the 2016 Alienware Case Mod-Off, Intel #ExpertMode Rig Wars, and so forth. Alaw's Golden Age mod (below left) was the coolest PC we saw at the event.

eSports events are a big deal these days, and PAX included plenty for fans to take in. The Overwatch Winter Premier Semi-Finals and Grand Finals were held in the PAX Arena over the course of the weekend, and plenty of attendees turned out to take it all in.

MASSIVE

# LANFest MLP Winter '017

On January 6, 7, and 8, AJ Pircio and his staff held another legendary MassiveLAN event at the Erie County Fairgrounds in Hamburg, NY. Many of the folks involved with this twice-yearly LAN party have been getting together to play games and have a great time for the better part of 13 years, and Pircio has this thing down to a science. In addition to the usual LAN party fare (tournaments in games like Counter-Strike: Global Offensive, Rocket League, League of Legends, and Overwatch), the 240-seat MLP '017 included cool stuff like a Duck Game tourney, a Rainbow Six Siege contest, and a ton of cool AFK events like a Mountain Dew taste test, Hard Drive Hockey, and a contest called Floppy Ninja where contestants try to knock down action figures on a table 20-ish feet away by tossing floppy disks at them.



Taking place so early in the year, MLP Winter '017 was a great way to close out the holiday season.



They start 'em young in western New York.





The Mountain Dew taste test challenged contestants to guess which Mountain Dew flavor was which while wearing blindfolds. Correct guesses were awarded by points, and the most points won!

One event that has become a favorite among MassiveLAN attendees is Hard Drive Hockey. Participants head outside into the frigid Hamburg evening and compete to shoot old hard drives into a goal using a hockey stick. "We didn't have an actual goal, because the one we used last year got broken during the event," Pircio says. "We even had one guy bring his own stick just for this event, which was awesome to see."





Competitive gaming requires lightning-quick reflexes and nerves of steel—especially when the game is Duck Game.



Ever played Floppy Ninja? MLP attendees have. "We set up a table with some action figures on it and pit two people against each other," Pircio says. "Their goal was to knock down the figures from about 20 feet away; figures were worth various points, and we had a single-elimination-style bracket." In the end, one of the MassiveLAN staff won the event, and Pircio says the crowd began a good-natured chant of "Rigged! Rigged! Rigged!" "But he truly did own it," Pircio says.

# Apex Predator

## Alphacool's Eiswolf 120 GPX Pro Hunts Down Heat

For an enthusiast attempting to achieve truly heroic levels of performance, few villains are as nefarious as heat. Whether you're aiming for a personal best overclock or trying to shatter an HWBot world record, runaway temperatures can quickly thwart your plans. Naturally, you're going to need allies if you expect to win such a battle.

Most power users, even beginners, should have no trouble tracking down a capable aftermarket cooler for their CPU, but graphics cards are another matter. Attaching an air cooler to a processor is second nature for DIY builders, and the spread of AIO (all-in-one) liquid coolers has made upgrading to watercooling a relatively painless affair. Graphics cards, on the other hand, roll out of the factory with a cooler preinstalled, so a lot of users, even enthusiasts, have never had a reason to install or upgrade their GPU cooler. Additionally, as AMD and NVIDIA allow their partners to riff on their cards' reference designs, slight variations in board layout may mean an aftermarket cooler for Company A's graphics card is incompatible with Company B's offering.

When someone does want to kick their GPU cooling up a notch, options are more limited compared to CPU coolers. Third-party graphics cards typically have refined heatsinks and fans that rival any aftermarket



You can hardly throw a processor without hitting an AIO (all-in-one) CPU liquid cooler, but closed-loop GPU coolers are decidedly more scarce. Seeing an opportunity to bring its expertise to this underserved market, Alphacool unleashed the Eiswolf 120 GPX Pro AIO for NVIDIA GeForce GTX 1080 and GTX 1070 graphics cards.

GPU air cooler, which usually pushes builders toward watercooling. And if you don't want to commit to a complete custom loop, your options further dwindle.

"Decent AIOs for graphics cards are basically non-existent on the market, other than hybrid solutions that rarely deliver sufficient performance," says Eduard Peters, Alphacool market manager.

Alphacool, one of the pioneers of custom liquid cooling, knows its way around a waterblock (and radiators, pumps, coolant,

etc.). The company, which is headquartered in Germany, set out to develop an AIO cooler for two of NVIDIA's most powerful graphics cards, the GeForce GTX 1080 and GTX 1070. The product of months of careful R&D, Alphacool's Eiswolf 120 GPX emerged from its factory ready to keep NVIDIA's powerful Pascal GPUs cool.

### A Wolf In Metal Clothing

Taming Pascal is no small order. When the GTX 1080 and 1070 run at full tilt,

"Decent AIOs for graphics cards are basically non-existent on the market, other than hybrid solutions that rarely deliver sufficient performance."

- Eduard Peters, Alphacool marketing manager

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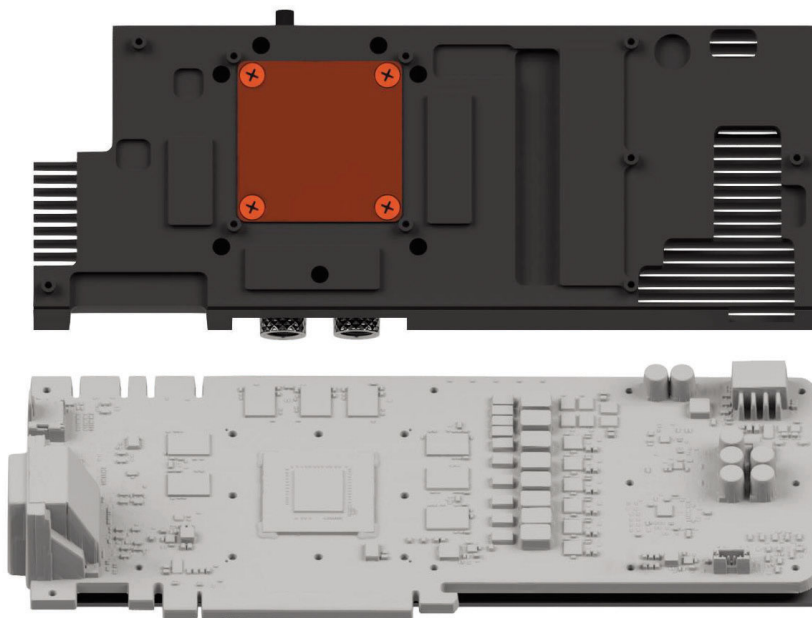
Alphacool's methodical approach to waterblock design includes using a 3D scanner to accurately survey the topography of each graphics card. After scanning a card, a process that can take up to four days, Alphacool can produce a precise 3D model as the basis for a matching block.

their core temp can crest to 94 degrees Celsius, which puts a tremendous burden on any cooler. When creating the Eiswolf 120 GPX, Alphacool's engineers paid attention to the present but also looked to the future . . . and NVIDIA's biggest competitor.

"We wanted to alter the familiar GPX waterblock's design, because [high-bandwidth memory] is just around the corner and will bring with it a new set of requirements," Peters says. "After testing an AMD Fury X, we have incorporated some further improvements. For example, we rotated the bottom plate of the waterblock and increased its size considerably in order to optimally cool the HBM storage. . . . The concept expanded from there."

Peters adds that aesthetics played a big role in the Eiswolf 120 GPX's design. After seeing some modders use markers to color over their graphics cards' PCB, Peters says that Alphacool opted for a full-cover waterblock that would conceal most of the graphic card's PCB.

Alphacool used its meticulous design process to develop the Eiswolf 120 GPX's waterblock. "We scan all graphics cards with

a 3D needle scanner, which takes around three to four days depending on the size of the PCB," Peters explains. "This gives us a scatter plot, which is transformed into vectors in order to make a 3D model of the card." Alphacool then identifies all the board components that require cooling (including minor elements such as MOSFETs) and matches them to the 3D model. Once Alphacool has developed the model, a 3D printer creates a prototype to test-fit the card, and designers make changes until the waterblock matches the card.

Aside from the waterblock, the Eiswolf 120 GPX features a complement of components that Alphacool created under its own roof. The AIO's 45mm-thick radiator shares its DNA with the company's NexXxos family of all-copper radiators. Pull the radiator apart, and you'll find copper everywhere—the cooling channels, of course, but also the fins and front chambers. In addition to superior thermal conductivity to aluminum, a radiator with wall-to-wall copper is an ideal mate for a copper waterblock. By maintaining consistency with the

metals used in the Eiswolf's closed loop, Alphacool takes galvanic corrosion out of the equation. Peters mentions that he's seen the effects of galvanic corrosion, when it breaks downs the channels with a radiator. He says that every metal in contact with the coolant flowing through Eiswolf is either copper or brass.

Alphacool mounts a pair of Eiswind sleeve bearing fans to either side of the Eiswolf's radiator. These PWM blowers can spin up to 1,700rpm under heavy load but can drop to 550rpm during periods of light use. When the fans are maxed out, they produce a maximum airflow of 63.85cfm, although that doesn't tell the whole story. Airflow is a perfectly good metric for case fans, but when a fan is bolted to a radiator, static pressure is king. With this in mind, Alphacool designed the Eiswind fans to deliver the necessary static pressure "punch" to force a lot of air through the Eiswolf's radiator fins. Alphacool rates the Eiswind's static pressure at an impressive 1.66mmH$_2$0. Set up in a push-pull configuration, the



The Eiswolf 120 GPX's secret weapon is its DC-LT 2600 ultra low-noise ceramic pump. The DC-LT 2600 is a suction pump, which reduces turbulence as it circulates coolant through the Eiswolf. The end result is a lower acoustic profile than traditional watercooling pumps.

Eiswind fans are well suited to blast air through the Eiswolf's thick 120mm radiator.

Alphacool extended its watercooling acumen right down to the coolant that courses through the Eiswolf's veins. Rather than using glycerin, which Peters says can eat away at any plastic, plexiglass, and PVC it contacts within a loop, Alphacool prefills the Eiswolf with Glysantin.

"Not everyone is familiar with the composition and possible materials used in a watercooling loop," he says. "The consequences of that can often be found in forum discussions."

## Pumped Up

Many users assume that the waterblock, radiator, and fans do all of the heavy lifting in a closed-loop cooler, but they forget about a component that can be either an unsung hero or unseen saboteur. Alphacool opted for the former as it developed the Eiswolf 120 GPX's integrated pump, a process that Peters says began in 2014.

"By the end of 2015, we had the first samples ready, which were tested independently by several reviewers. All of them were very enthusiastic about the concept, which encouraged us to perfect it and make it market-ready."

Contrary to some watercooling manu-facturers, which tend to rely on ODMs for their coolers' pumps (and often more than that), Alphacool builds a number of its pumps in house. Nestled within the Eiswolf's waterblock is the Alphacool DC-LT 2600 ultra low-noise ceramic pump, which has a neat trick up its sleeve. Alphacool abandoned the traditional pump design and made the DC-LT 2600 a suction pump. According to Peters, the pump draws in coolant from the opposite direction; the coolant flows from the outer channel through waterblock's cross-slot structure. Then, the suction principle pulls the coolant up through the middle of the pump. Ultimately, the Eiswolf's suction pump cuts down on turbulence as coolant flows through loop, diminishing pump noise to the point that the pump is almost silent.

## Presto Chango

Part of the appeal of AIO liquid coolers is that they're essentially ready to go as soon as they're unboxed. However, closed-loop coolers regularly require builders to pay for that convenience by forfeiting an upgrade path in the future, since the tubing is effectively fused to the cooler's waterblock and radiator. Alphacool didn't want the Eiswolf to hamstring its customers' upgrade plans, so the company took steps to keep enthusiasts' options open.

The Eiswolf can easily link up with other Alphacool liquid-cooling hardware, notably its Eisbaer CPU AIO, but you can add it to any custom loop. For the former, separate the Eiswolf's quick-release connectors and then combine them with the Eisbaer's connectors. For other loops, the Eiswolf's standard G1/4 fittings let you incorporate the Eiswolf's waterblock and radiator with other companies' cooling gear.

### Alpha Wolf

For first-timers, liquid-cooling a high-end GPU such as NVIDIA's Pascal is a daunting process. Alphacool's Eiswolf 120 GPX takes a lot of guesswork out of the equation and a lot of heat away from a GPU. ■



Alphacool's Eiswolf 120 GPX works perfectly well as a self-contained unit, but it's built to be easily expandable. Sporting a pair of quick-release connectors (top), the Eiswolf can join forces with Alphacool's Eisbaer AIO CPU cooler in a matter of seconds. Beyond that, the Eiswolf uses standard G1/4 fittings (bottom), so you can incorporate it into custom loops, as well.

Titans Of eSports

# Counter Logic Gaming's Formula For Success

For a vast majority of us, gaming is a pastime that we enjoy in the in-between hours, when we get off work or school, when the kids are in bed, or whenever there's a free moment. But for professional gamers, that leisure activity is forged into a career and honed into a lifestyle. Nowhere is that truer than it is at Counter Logic Gaming, one of the premier eSports organizations in North America. At the Los Angeles-based headquarters, players, coaches, and a dedicated team of support staff work tirelessly to compete and win in global tournaments for League of Legends, Counter Strike: Global Offensive, Super Smash Bros., Overwatch, and more.

To bring you an in-depth look at the inner workings of the organization and the world of eSports itself, we spoke to Matt "Trinitiii" Nausha, CLG Director of eSports; Tony "Zikzlol" Gray, LoL LCS Head Coach; Chet "Imapet" Singh, CS:GO Blue Team Strategic Coach; and Matthew Hwu, Head of Physical Performance and eSports Medicine.

**Q**: Can you describe an average day in the life of a team member at the CLG house during the competition season?

**MN**: An average day for a competitive player begins with breakfast prepared by the cook [Andrew "mnqcook" Tye] at the main house. Players will eat and interact with players from different teams. Coaches and staff members are also present at the meals. After breakfast is completed, players will go to the gym or will run personal errands. Practice will start around 12:00pm if there are no matches that day. Practices will include VOD reviews, scouting, drills, and scrimmages. The teams will take a break around 3:00pm where they will eat lunch prepared by the cook at the main house. Practice will resume until 7:00pm where the teams will then break and eat dinner. Usually, most teams and players are present at dinner. This is a great opportunity for those in the organization to connect with one another. After dinner, most teams will break for the day. Oftentimes players will choose to keep practicing.

**Q**: How does a team prepare for a tournament?



**MN**: Typically, a team will prepare by having a boot camp. These boot camps usually entail longer days than a normal practice. Each day is focused specifically towards the tournament. Coaches scout and prepare for multiple teams rather than just one for a normal league match. The coaches will analyze each team in preparation for the tournament. This includes watching film and understanding the opponent's strategies. The coaches will educate the players on and develop strategies specific to each upcoming opponent. During boot camps there is an emphasis on preparation both mechanically and mentally.

Full-time cook Andrew Tye helps fuel Counter Logic Gaming's competitive spirit.

**Q: What are the head coach's primary duties?**

TG: My primary duty as head coach is to constantly move the team in the right direction and consistently challenge my staff and players in practice to be the best people they can be in order to get the most out of the time we set aside to train.

**Q: How does the head coach job differ from that of the player development coach?**

TG: I'd say that Grant Rousseau, our Player Development Coach, focuses primarily on the out-of-game development to make sure that they are not just elite gamers, but also elite people.

**Q: What does the coach do during a match?**

TG: During training, a coach has a lot of options to talk during matches to change how practice is going, but when it comes to game day, there's no player-coach interaction outside of a short 10-15 minute break between games. Mostly the talks between games of a set can cover topics such as needing to change our focus strategically, or how we view things mentally.



The coaches are always in the background ready to redirect, encourage, and congratulate, even if only between matches.

**Q: What changes for the CLG teams during the off-season?**

TG: The competitive gaming off-season for League of Legends is a small period after Worlds [the League of Legends World Championship] prior to the next season, which only really covers the months of November and December. With Worlds ending in late October and a new season right around the corner in January, there isn't much time for staff to really enjoy their time off. Taking anything longer than a three-week break can be a bad decision, due to the fact that there are so many changes to rosters and ways that you can improve your systems to make training or competition more efficient. If you aren't always pushing yourself to improve your team and your systems, you will fall behind in competition.

**Q: What are some of the difficulties young players encounter as pro gamers?**

MN: The hardest thing to balance is being a professional player are relationships. Relationships with friends,

significant others, and family members can be hard to maintain during the competitive season. There is a lot of sacrifice that needs to be made to dedicate yourself to being a professional player.

**Q: What are some of the roles that players take on in games that don't employ traditional classes, such as CS:GO?**

CS: In CS:GO players take on specific roles, which include In-Game Leader, supporting, entry fragging, AWPing and/or lurking. In-Game Leading is probably the most crucial role in CS:GO; it requires a player to completely dedicate themselves to put their players in positions to take map control, execute strategies, and help players rotate around the map. A support player is usually someone who puts themselves in positions to set up other players (i.e. throwing flashes and smokes) and help them succeed, usually entry fraggers. An entry fragger is the guy who is going to go first in most of the team's strategies. He might not always get a kill but he can get valuable information on where the enemy is and how they are set up. This information can influence the IGL's decision on what bomb site the team



Team CLG Red takes a break to smile for the camera.

should take. The AWPer is usually the guy who you will almost always give the AWP [Arctic Warfare Police, bolt-action sniper rifle] to, you can trust this player to get entries. The AWPer can open up rounds by getting quicks on [Terrorist] side and on [Counter Terrorist] side, and then just hold position passively like a turret and lock down bomb sites. The lurking role, which is the simplest role, usually just involves a player to cut off rotations so when your team starts executing onto a site, anyone coming from the other side of the map has to deal with the possibility of someone coming from behind and trying to kill them or they have to deal with searching and wasting time finding that lurker so they don't die from behind before they try to retake a bomb site.

**Q: Do team members ever switch roles?**

CS: Team members occasionally switch roles. Teams usually do this when they feel like they're in slumps so they can try out some fresh ideas and create a new team identity if they don't want to go down the route of changing the roster.

**Q: How important is CLG's fan community and the eSports fan community at large?**

MN: Having a community is very important. I would argue it is one



There's a whole lot of practice, training, and hard work behind every one of CLG's wins.

of the most important parts of being a premier eSports organization. We like to connect with our fans as often as we can. This is done at conventions and online. Recently we started a public Discord channel that anyone can join (clg.gg/CLGdiscord). This gives anyone access to speak directly to any player, coach, or staff member. This includes HotshotGG! I believe having an outspoken community is a positive for the organization. Personally, I believe the voice of the community keeps the organization accountable.

Q: At the CLG House, there are a bunch of people trying to live and work together and it sounds like there's a lot of opportunity for some solid life experience to happen. Is this the case?

MN: Yes, the coaches and staff are technically in charge. The majority of players do not need much direction and are respectful of the rules that I have set in place for the homes. I would say for younger players that have never lived away from home, they get a lot of good life experience. Meals are provided to the players. However, there are many life skills that players must possess to be successful in the gaming house. There are a lot of interesting things that happen in the home and I do believe it would make a great reality show. The organization has a wide variety of personalities and some very funny people. By following our social media, you can see many of these experiences as they happen every day.

Q: Is it sometimes difficult to balance work and free time, or establish and maintain personal boundaries in such an environment?

MN: I would say this is the hardest thing I struggle with. My objective is to assist players and teams to be the best they can. At the same time, I recognize the importance of players having balance in their life. Finding that balance can be hard at times. It is something that I am very cognizant of. I work directly with coaches to assist in identifying burnout and maintaining balance for the players. Having strong personal boundaries is important to have in this environment. Nearly everyone



Counter Logic Gaming is as fanatical about its community as they are about CLG, and they show their appreciation by often hosting giveaways, sometimes for cool gear like these DXRacer CLG gaming chairs.



Regular exercise is a crucial way to prevent repetitive stress injuries.

in the organization works and lives in the same location. As staff we demonstrate strong boundaries for players.

**Q: With so much time spent gaming, are injuries and fatigue a problem?**

**MH**: Absolutely. Injuries and fatigue (both physical and mental) are both issues that are expected with the extended play along with the stress factor, which typically accompanies specific high-action moments within the game. Players spend upwards of 10 to 14 hours a day on their computer practicing and occasionally during competition, often at higher actions per minute than your standard sedentary job.

This itself leads to a risk for injuries along the fingers, wrist, hand, and even further up the arm into the trunk (shoulder, neck, and back). This is always on our radar and we address it in several ways. Prevention is always the main focus with repetitive strain—the most common injury within eSports—through proper exercise, lifestyle changes, and management of their posture and ergonomics. It is important that our athletes participate in regular exercise routines, which specifically target the



Preparation and skill are the keys to victory, but having the right hardware doesn't hurt.

muscles most commonly used in eSports, such as postural endurance muscles for holding us up while we sit along with the hand, wrist, and forearm muscles with the excessive clicking and typing.

As a Physical Therapist, I am available for the players at any time if they have any complaints of pain or discomfort. Fortunately, our players have all been quite healthy with our infrastructure and have not had any major issues that have limited or affected their performance. Prior to tournaments or competitive play, we do occasionally initiate warm-up routines for injury prevention purposes.

**Q: After a hard day of gaming, what to the staff and gamers at Counter Logic Gaming do to unwind?**

**MN**: Super Smash Bros. appears to be the game that a majority of people in the organization play. There is a TV near the kitchen in the main house that will either have a GameCube or Wii set up. Oftentimes, people will have quick matches before or after dinner. Two other games that many people in the organization are currently playing are Battlerite and Overwatch. Board games are also very popular in the organization. It is not uncommon for 10 or more people to be playing a board game any given night. ■



There are various roles players must take on to succeed in competitive gaming's highest ranks.

## Modder Q&A: Marc Molella

# One Fan Hole & He Was Hooked

Marc "marcam923" Molella is the founder and CEO of the PC building and modding site PrecisionComputing.net. His mods have appeared twice in *CPU*'s "Mad Reader Mod" feature, first in the September 2015 issue when his RevoluTtion mod won the Case Mod category at the QuakeCon mod contest, and again in our May 2016 issue when we chose his Fallout Rig as MRM. His work has also appeared on GeForce Garage, Intel's #ExpertMode Rig Wars, and more.

**Q: Back in 2015, you told us in our Mad Reader Mod coverage of your RevoluTtion mod that you began modding primarily for performance reasons, to improve ventilation and the like. When was that, and where'd you get the idea to start cutting in the first place?**

MM: I began modding in roughly 2004 to 2005. I had been building computers for about 10 years at the time, but on a small scale, maybe one every couple years or so. By 2004, I started to get into overclocking; shortly after that the Intel Core 2 Duo chips were arriving on the market, and I started to get into gaming via LAN with friends at our different houses locally. As we gamed more and more and had multiple rigs in the same room for long sessions, heat became a factor. I could not afford an expensive case that already had great airflow, although in my frequent trips to Fry's Electronics and Micro Center, I often would check them out to see what I could improve about my own case. Coming from an automotive background and always working on cars, I had multiple air tools, and cutting tools, like tin snips, a Dremel, an angle grinder, and so on. I actually cut my first fan hole with snips, and was very rough, but I used some door edge guard to protect the edges that I had from the automotive work I did, and so the overall look wasn't half bad. That just started the modding itch, and it was all downhill from there!



**Q: How long after that did you start doing more aesthetic-based mods, and what was your first one?**

MM: My first ever mod turned into an aesthetic and performance-based mod. I always try to not just improve the design or aesthetics of a case when modding, but also to improve on the overall case concept. Take something great and make it better. Once I had cut into the case (this was the era of silver cases), I noticed how the silver paint from the factory Diablotek case was different on the plastic pieces of the case than on the metal pieces. So with my love for Superman, I decided to repaint the entire case silver so everything was matching, add some blue accents and lighting, and of course a cool, backlit Superman logo on the backside of the case.

**Q: Is there one modder in particular whose work inspired you to start doing aesthetic mods? Who was it, and what about their work got you started?**

MM: Back when I started, I was new to forums, and the entire enthusiast scene. It was the passion for performance that drove me to want to make my rig perform better

Molella's favorite mod project to date is this one: RevoluTtion. This gorgeous mod won first place in the QuakeCon 2015 Case Mod category, and was our Mad Reader Mod for September 2015.



My favorite event to date was Rig Wars; even though it was a competition, it was friendly, and just felt like I was in a shop modding and building with a couple good friends, which Travis and Hassan are. That event helped me grow a friendship even stronger to this day with those two great guys, and for that I am grateful for the experience.

**Q**: How many complete mod projects have you done since you started modding, and which one of all them is your favorite?

**MM**: Well, complete mod projects I would say somewhere in the ballpark of 25 to 50 mods, the more I think about it, the more I remember.

**Q**: Your first Mad Reader Mod win was part of our coverage of the QuakeCon 2015 mod contest; how many QuakeCons have you been to now, and how often do you take a new mod to the event?

**MM**: I have actually only been to QuakeCon twice; 2015 was my first year in attendance. So in the two years, if you consider the live modding, I had three mods at the events. One I brought each year, and one created on site.

**Q**: What are your favorite and least favorite parts of every mod project, and why?

**MM**: Most of the time, projects have a limited time frame, so my least favorite part is trying to stay within time constraints to create the vision that is in my head, although so far I haven't missed a deadline. My favorite part is twofold: happy accidents and paint work. Happy accidents are when something turns out better than I could have imagined, and I love the end results of quality paint work. Seeing the gloss come to life is very rewarding to me.

**Q**: If someone told you they wanted to start modding and asked you what tool or piece of equipment they

and competition between local friends that I gamed with. I believe the one name that I can remember from when I started was Mnpctech. But I found their website when searching for some mod parts and watercooling gear, and had not taken an interest in their mods at that point.

**Q**: You've been involved with several modding events in recent years (Rig Wars, 24 Hours of Le Mods, and so forth). What has been your favorite event moment so far, and why?

**MM**: Honestly, I loved the 24-hour live modding, but it was tiring.

should buy first, what would you tell them, and why?

**MM**: The first thing I tell people to do that want to start modding is to go out to their garage, gather some tools they already own, an old case, or scrap metal, even cardboard, and see what their hands can create. Our hands are the two most important modding tools we have, next to our creativity. Everyone has an ability to mod, whether through 3D design, photo editing, woodwork, metal work, etc. . . . . We just all have to find what we are good at and start a project, and the results will be epic! For a tool to go out and buy, a Dremel, as it is the most versatile to use across any modding material.

**Q**: What do you look for first in a case when starting a new mod project?

**MM**: Everything has to be cohesive. When starting a project, I choose parts from the case to the components to ensure they all flow together and fit the overall theme or mod. So it all depends on the mod that I am about to take on. But when choosing a case in general, I always look for one that has great airflow and modularity. From there, the tools do the rest.

**Q**: It's time for Five Quick Questions!

1) Intel or AMD?

Intel.

2) Coke or Pepsi?

Pepsi.

3) Matte or high-gloss?

High-gloss.

4) "The Simpsons" or "Family Guy"?

The Simpsons.

5) EATX or Mini-ITX?

EATX. ∎

# A Hot Lead

## Find Your Next Power Supply

Traditional marketing jargon for power supplies—"superb stability," "whisper-quiet," and "greater efficiency"—might sound more like promotional material for a home appliance than a PC part. But like a home appliance, we need a power supply to function perfectly every time we use it. Not every PSU, unfortunately, is up to the task for enthusiast rigs where continuous clean power is absolutely critical.

**Wattage**
As graphics cards and processors become more power-efficient, we're starting to see less of a demand for high-wattage (1000 watts and up) power supplies. PSU manufacturers still continue to make high-wattage PSUs, but the best selection (and the sweet spot for pricing) is generally found between 600 and 800 watts. NVIDIA's lack of support for 3-way and 4-way SLI with its 10 Series GPUs also reduces the need for kilowatt-plus PSUs.

**Efficiency**
Steady advancements in power supply efficiency have led to the creation of multiple 80 PLUS certifications. 80 PLUS Titanium is currently the top level, requiring a PSU to be at least 90% efficient at 10%, 20%, 50%, and 100% loads, but not many PSUs reach such lofty standards. 80 PLUS Platinum (the second-highest certification) and Gold (third-highest) are far more common. Besides a small break on your electric bill, higher efficiency models tend to produce less heat.

**SFX Form Factor**
To maximize space, some small form factor cases require the use of an SFX power supply. In the past, the miniature SFX form factor offered limited support for power-user wattages and connectivity, but newer models reach between 500 and 700 watts. And with more juice, PSU makers can include multiple PCIe connectors to support a powerful GPU. It's never been easier to build a powerful small form factor rig.

We know that your components and budget play a huge role in selecting a power supply, so you'll find a wide variety of wattages and price points in our buyer's guide. For easy comparison, there's a chart at the end containing each unit's key specifications.

# be quiet! Pure Power 10 600W CM

$75.90
www.bequiet.com

**Why You'll Dig It:** be quiet! makes a number of big improvements to its Pure Power 10 lineup, while still retaining the reasonable pricing that has made the PSUs so popular. The Pure Power 10 600W CM, for example, meets the 80 PLUS Silver certification and boasts a temperature-controlled 120mm fan that's nearly silent under most loads. For stability, be quiet! uses both active clamp and synchronous rectifier technology, as well as DC-to-DC power conversion. Besides the internal upgrades, be quiet! also enhances the Pure Power 10's modular cabling with high-quality flat ribbon cables for the PCIe connectors and system drives. There are two +12V rails—one 32A and one 28A—that the Pure Power 10 600W CM safeguards against overcurrent, overvoltage, undervoltage, overtemperature, overpower, and short-circuit conditions.

**Who Should Apply:** Power users who want an efficient, modular power supply that won't stretch the build's budget.

Total Power: 600 watts
Number Of +12V Rails: 2 (32A & 28A)
80 PLUS Certification: Silver

# Aerocool VX-700W

$69.99
www.aerocool.us

**Why You'll Dig It:** The VX-700W comes at an entry-level price, yet can accommodate at least one powerful GPU, thanks to a 54A +12V rail and two PCIe 6+2-pin connectors. Aerocool integrates a variety of electrical protections, so the VX-700 won't let your PC hardware be damaged by power fluctuations. The PSU protects against overpower, overvoltage, undervoltage, and short-circuit conditions. The VX-700's connector options are well thought out. There's a 20+4-pin main power, one 4+4-pin EPS12V (to power the CPU), and two PCIe 6+2-pin connectors. The VX-700 also provides six SATA connectors, three Molex cables, and one floppy connector for I/O devices and fans, among others. If VX-700 seems like more power than you'll need, Aerocool also offers a VX-500 that retails for only $39.99.

**Who Should Apply:** People in need of an affordable, reliable PSU that has all the connectivity you'll need for a modern build.

Total Power: 700 watts
Number Of +12V Rails: 1 (54A)
80 PLUS Certification: None

# Zalman ZM500-LE

$32.99
www.zalman.com

**Why You'll Dig It:** The LE-Series from Zalman drops many of the bells and whistles you'll find on higher-end Zalman models, but it still provides the reliability you want in a PSU. For example, two-forward switching circuitry lowers power loss to improve lifespan, and there's heavy-duty protection for overvoltage, undervoltage, overpower, and short-circuit conditions. Best of all, Zalman sells the ZM500-LE for only $32.99. To reduce energy consumption in standby, Zalman also installs Green IC circuitry to consume less than one watt when the PC is in Sleep mode. The ZM500-LE features two +12V rails each rated for 20A, while the +5V rail supports up to 15A and the +3.3V peaks at 18A. A 120mm sleeve bearing fan offers quiet performance under all conditions.

**Who Should Apply:** System builders looking for a power supply that provides a variety of features to ensure reliability and stable power delivery for a basic rig.

Total Power: 500 watts
Number Of +12V Rails: 2 (20A)
80 PLUS Certification: None

# Rosewill HIVE-650S

$54.99 (using promocode MARCHFRENZY, normally $64.99)
www.rosewill.com

**Why You'll Dig It:** Rosewill hardwires only the 20 + 4-pin main power and 4+4-pin +12V ATX power connectors to keep the essential connectors, while the rest of the cables are modular to minimize cable clutter. To support full-size gaming towers, the HIVE-650S comes with extra long cables. Rosewill installs a 135mm PWM fan; using a large diameter fan helps to reduce noise generated by the PSU—both in idle and under load. The HIVE-650S meets the 80 PLUS Bronze certification with an efficiency of 84% at 20% load and 86.5% at 50% load. For maximum safety, you'll find built-in protections against overtemperature, overcurrent, overvoltage, and overpower, as well as undervoltage and short circuits. During March, you can purchase the HIVE-650S for only $54.99 at Newegg using promocode MARCHFRENZY.

**Who Should Apply:** Builders who want to spend a minimal amount on a PSU, but who still want built-in safety against power fluctuations and the necessary connectors to handle a gaming system.

Total Power: 650 watts
Number Of +12V Rails: 1 (48.75A)
80 PLUS Certification: Bronze

# be quiet! Dark Power Pro 11 1200W

$239.90
www.bequiet.com

**Why You'll Dig It:** The Dark Power Pro 11 lineup boasts be quiet!'s premium power conversion technology, including full bridge and synchronous rectifier topology for low power loss and switching efficiency. This PSU also features DC-to-DC technology that increases the PSU's overall energy efficiency. 80 PLUS testing backs up the efficiency claims, as the Dark Power Pro 11 1200W meets the 80 PLUS Platinum certification. We've always liked be quiet!'s fans, and the Dark Power Pro 11 1200W comes with the company's SilentWings 3 135mm fan that severely cuts down on noise. At 50% load, for instance, be quiet! rates the Dark Power Pro 11 1200W's noise level at only 11.5db(A).

**Who Should Apply:** Builders who want to ensure their components are receiving clean, stable power by using a PSU with sophisticated technology for tight regulation.

Total Power: 1,200 watts
Number Of +12V Rails: 4 (2 x 35A, 2 x 45A)
80 PLUS Certification: Platinum

# FSP AURUM PT 850W

$169.99
http://www.fsplifestyle.com

**Why You'll Dig It:** The AURUM PT Series is designed for overclockers and gamers. FSP installs industrial-grade Japanese capacitors, as well as solid capacitors on the secondary side to suppress ripple that can create errors or crashes when overclocking. FSP also uses its E-Sync Remote-Sensing technology for flawless voltage stability over the +12V, +5V, and +3.3V rails. FSP utilizes the high-quality components to produce excellent efficiency (up to 92%) and the AURUM PT 850W is certified 80 PLUS Platinum. The completely modular power supply comes with 13 SATA, eight 6+2-pin PCIe, and two 4+4-pin EPS connectors (among others) to power most any modern build. A 135mm, fluid dynamic bearing fan provides quiet cooling and further helps to ensure reliable power delivery. The AURUM PT 850W is equipped with a +12V rail rated for up to 70A to handle powerful builds.

**Who Should Apply:** Enthusiasts who want a mix of eco-friendly, high-performance, and innovative features from their power supply.

Total Power: 850 watts
Number Of +12V Rails: 1 (70A)
80 PLUS Certification: Platinum

# Corsair RM1000i

$199.99
www.corsair.com

**Why You'll Dig It:** Corsair's RMi series power supplies communicate with Corsair Link software to let you monitor and log fan speed, voltages, and power consumption during use. If you fancy a multiple +12V setup rather than a single +12V rail, you can also toggle the RM1000i to a multi-rail mode inside Corsair Link. The high performance PSU is quiet, thanks to a load controlled fan that only starts spinning when power output goes above 400 watts. The digitally-controlled PSU offers tight voltage regulation and is certified 80 PLUS Gold. For long term reliability, Corsair uses 100% Japanese capacitors rated for temperatures up to 105 degree Celsius. Did we mention it's covered by a 10-year warranty? The RMi series is also available in 850W, 750W, and 650W power capacties.

**Who Should Apply:** Builders who are looking for complete control of the power going into their PC. It's also a good choice for those concerned most about power supply reliability.

Total Power: 1000 watts
Number Of +12V Rails: 1 (83.3A) or up to 8 (40A) rails
80 PLUS Certification: Gold

# Aerocool XPredator 1000GM

$109.99
www.aerocool.us

**Why You'll Dig It:** The XPredator 1000GM features DC-to-DC topology for optimal voltage regulation and high-efficiency performance. 80 PLUS testing shows that this PSU is indeed efficient, as it meets the 80 PLUS Gold certification with an efficiency of 90.67% at 50% load and 89.41% at 20% load. Much of the XPredator 1000GM's power is distributed over the +12V rail, which can support up to 83A to ensure that hungry graphics cards get the power they need. The PSU includes eight 6+2-pin PCIe connectors to support multiple GPU configurations. The XPredator 1000GM is stealthy, thanks to a load-controlled PWM fan that operates at less than 1,000rpm when the PSU's output is under 60% load. To keep things cool, the PSU's fan will ramp up to 2,100rpm when load demands. Aerocool also offers a XPredator 750GM for $89.99.

**Who Should Apply:** Enthusiasts who need a big wattage PSU that doesn't come with a big price tag.

Total Power: 1000 watts
Number Of +12V Rails: 1 (83A)
80 PLUS Certification: Gold

# GIGABYTE XP1200M

$279

www.gigabyte.us

**Why You'll Dig It:** The XP1200M is the first GIGABYTE power supply to earn the XTREME GAMING moniker, and with 1200 watts of power, this PSU easily supports multiple GPU configurations. The XP1200M's huge 100A +12V rail is also good for overclocking duties. For reliable performance, GIGABYTE uses Rubycon Japanese capacitors with a rated lifespan of more than 20 years. The XP1200M is backed with a five-year warranty. Power is efficiently delivered to your system's components, as the XP1200M meets the 80 PLUS Platinum certification. The PSU's high-quality design helps to generate clean power to your components. Even with a rig full of hardware, the XP1200M should have no problem powering everything in your system. GIGABYTE provides 12 SATA, eight Molex, and two Molex-to-floppy adapters. To power your graphics cards, there are six 6+2-pin PCIe connectors.

**Who Should Apply:** System builders with multiple graphics cards who want plenty of PSU power in reserve.

Total Power: 1200 watts
Number Of +12V Rails: 1 (100A)
80 PLUS Certification: Platinum

# ENERMAX REVOLUTION DUO 600W

$89.99

www.enermax.com

**Why You'll Dig It:** ENERMAX's new REVOLUTION DUO 600W features two fans (a 100mm intake and an 80mm exhaust) to actively force heat out the PSU's rear panel. The DUOFlow design allows ENERMAX to opt for lower rpm ranges and minimize the PSU's acoustic footprint. ENERMAX rates the REVOLUTION DUO 600W for a maximum noise level of 20.9dBA, while similar 600W PSUs with a single fan often produce up to 27dB(A) of noise. You can also manually adjust the PSU's fan speed via a control knob on the rear of the unit to further control noise. The REVOLUTION DUO 600W features a single +12V rail rated for 50A and up to 600 watts of power. ENERMAX protects the +12V rail with overvoltage, undervoltage, overpower, overcurrent, and short circuit safeguards. The +3.3V and +5V rails both deliver up to 20A of current and are also monitored for overcurrent conditions.

**Who Should Apply:** Quiet computing enthusiasts who want a PSU that operates unobtrusively in both idle and under load.

Total Power: 600 watts
Number Of +12V Rails: 1 (50A)
80 PLUS Certification: Gold

## Fractal Design Integra M 750W

$89.99
www.fractal-design.com

**Why You'll Dig It:** Fractal Design targets the Integra M lineup at medium performance gaming PCs and workstations with 750W, 650W, 550W, and 450W options. Fractal Design uses a semi-modular design where only the necessary connectors (the 750W, for example, features a 20+4-pin, EPS 4+4-pin, and two PCIe 6+2-pin) are hardwired to the PSU. The remaining connectors are available via flat, modular cables. On the Integra M 750W, the modular cabling adds two more PCIe 6+2-pin connectors, as well as seven SATA and two Molex connectors. The Integra M lineup features a temperature-controlled, sleeve-bearing 120mm fan for minimal noise. For maximum compatibility, Fractal Design manages to fit all the internals into a 140mm deep case that should work with the smallest ATX-compatible cases.

**Who Should Apply:** Mainstream buyers and enthusiasts looking for a reasonable priced PSU equipped with today's most popular conveniences.

Total Power: 750 watts
Number Of +12V Rails: 1 (62.5A)
80 PLUS Certification: Bronze

## Zalman ZM750-EBT

$89.99
www.zalman.com

**Why You'll Dig It:** Backed by a seven-year warranty, Zalman's new ZM750-EBT PSU is built with high-quality Rubycon solid state capacitors rated to function at up to 105 degree Celsius. In short, it's built to last. For efficiency and reliability, Zalman also adds an LLC converter circuit, as well as a DC-to-DC converter and active PFC. The ZM750-EBT meets the 80 PLUS Gold certification with efficiency levels between 87 and 92%. Impressively, Zalman is able to incorporate the latest PSU amenities while keeping the PSU's cost to less than $100. The ZM750-EBT features a 62.5A +12V rail that should easily handle a CPU overclock and multiple GPUs. For the latter, Zalman includes four PCIe 6+2-pin connectors split among two cables—each of which is nearly 20 inches long. The semi-modular PSU also features four SATA/peripheral sockets and provides up to eight SATA and six Molex connectors.

**Who Should Apply:** System builders who want a power supply that's been designed for reliability and comes with a long warranty to ensure operation throughout the lifetime of the PC.

Total Power: 750 watts
Number Of +12V Rails: 1 (62.5A)
80 PLUS Certification: Gold

# Rosewill PHOTON-650

$64.99 (using promocode MARCHFRENZY, normally $74.99)
www.rosewill.com

**Why You'll Dig It:** It's built with 100% high-quality Japanese capacitors and meets the 80 PLUS Gold certification by delivering over 90% efficiency. The PHOTON-650 boasts completely modular cabling, which should help you to avoid unnecessary clutter and improve system airflow. The PHOTON-650 features a strong, 54.2A +12V rail to deliver the PSU's full total power (650 watts) over the primary rail. The robust +12V rail also allows Rosewill to include four 6+2-pin PCIe connectors to power a high-end CrossFire or SLI configuration. Connectivity for the rest of your system hardware is excellent, with eight SATA connectors, four Molex connectors, and a FDD connector. Rosewill goes the extra mile, too, by providing cable ties and a bag for the modular cables you don't use. The PHOTON-650 is backed by a five-year warranty. During March, use promocode MARCHFRENZY at Newegg to drop the price to $64.99.

**Who Should Apply:** Gamers in need of an efficient, modular power supply that won't break the bank.

Total Power: 650 watts
Number Of +12V Rails: 1 (54.2a)
80 PLUS Certification: Gold

# Corsair TX650M

$89.99
www.corsair.com

**Why You'll Dig It:** Love Corsair power supplies, but don't have the scratch for a top-end model? The TX-M lineup comes with many of the best features from the high-end PSUs, while still fitting into most budgets. The TX650M, for example, is a semi-modular power supply that boasts 80 PLUS gold efficiency, is tested for maximum power at 50 C, and comes with a seven-year warranty. The power supply features multiple layers of protection to prevent abnormal voltage, current, power, and temperatures from turning your elite rig into a very expensive paperweight. The TX650M can power a high-end graphics card setup via the four 6+2-pin PCIe connectors, which are split among two 23.6-inch cables. The TX-M lineup is also available in 850W, 750W, and 550W models.

**Who Should Apply:** Enthusiasts who want a power supply that will provide reliable, stable power to their midrange build. The affordable PSU also provides the connectivity you'll need to run multiple graphics cards in your system.

Total Power: 650 watts
Number Of +12V Rails: 1 (51A)
80 PLUS Certification: Gold

# Corsair RM850x

$159.99
www.corsair.com

**Why You'll Dig It:** The RMx series is designed to last you through your current build and beyond. Corsair tests the completely modular RMx models at 50 C, so you can be sure the PSUs provide the rated power, even in cases filled with heat-generating components. The RM850x also won't increase temperatures in your rig, as the PSU's high-efficiency operation (80 PLUS Gold) helps reduce waste heat. The high-efficiency design also allows Corsair to suspend fan rotation until load demands, and even then, it's unlikely you'll hear the 135mm fan over other system components. Corsair is so confident in the RMx series, it backs the PSUs with a 10-year warranty. There's plenty of connectivity to power a high-end build with two EPS, six PCIe, 10 SATA, and eight Molex connectors. Most of the modular cables are flat to make cable routing easier and improve airflow inside your case.

**Who Should Apply:** System builders who want a quiet power supply that's been tested for reliability and comes with a long warranty to ensure operation throughout the lifetime of the PC.

Total Power: 850 watts
Number Of +12V Rails: 1 (70.8A)
80 PLUS Certification: Gold

# ENERMAX REVOLUTION SFX 650W

$124.99
www.enermax.com

**Why You'll Dig It:** A fair number of small form factor cases, such as ENERMAX's STEELWING, now require an SFX power supply, which is much smaller than a standard ATX PSU. The REVOLUTION SFX 650W is one of the highest wattage SFX PSUs on the market, and according to ENERMAX, it's the highest wattage SFX PSU with a standard 3.94-inch depth. Outside of the REVOLUTION SFX 650W's small dimensions, the PSU offers the connectivity and features you'd expect on an enthusiast-level 650 watt power supply. The REVOLUTION SFX 650W meets the 80 PLUS Gold certification, is fully modular, and comes with a PWM controlled fan for quiet operation. The REVOLUTION SFX 650W's 80mm fan won't start spinning until load goes above 195 watts, which means the unit will be completely silent when your PC is idle.

**Who Should Apply:** Small form factor builders who want one of the highest power SFX PSUs on the market.

Total Power: 650 watts
Number Of +12V Rails: 1 (54A)
80 PLUS Certification: Gold

**www.booksmania.net**

| Power Supply | Price | 12V Rails | 80 Plus Certification | PCIe Connectors | SATA Connectors | 4-pin Molex Connectors | Warranty |
|---|---|---|---|---|---|---|---|
| GIGABYTE XP1200M | $279 | 1 (100A) | Platinum | 6 | 12 | 8 | 5 years |
| be quiet! Dark Power Pro 11 1200W | $239.90 | 4 (2 x 35A, 2 x 45A) | Platinum | 9 | 10 | 7 | 5 years |
| Corsair RM1000i | $199.99 | 1 (83.3A) | Gold | 8 | 12 | 11 | 10 years |
| FSP AURUM PT 850W | $169.99 | 1 (70A) | Platinum | 8 | 13 | 6 | 7 years |
| Corsair RM850x | $159.99 | 1 (70.8A) | Gold | 6 | 10 | 8 | 10 years |
| ENERMAX REVOLUTION SFX 650W | $124.99 | 1 (54A) | Gold | 2 | 6 | 4 | 5 years |
| Aerocool XPredator 1000GM | $109.99 | 1 (83A) | Gold | 8 | 10 | 6 | 2 years |
| Fractal Design Integra M 750W | $89.99 | 1 (62.5A) | Bronze | 4 | 7 | 2 | 3 years |
| ENERMAX REVOLUTION DUO 600W | $89.99 | 1 (50A) | Gold | 2 | 6 | 4 | 3 years |
| Zalman ZM750-EBT | $89.99 | 1 (62.5A) | Gold | 4 | 8 | 6 | 7 years |
| Corsair TX650M | $89.99 | 1 (51A) | Gold | 4 | 6 | 4 | 7 years |
| be quiet! Pure Power 10 600W CM | $75.90 | 2 (32A, 28A) | Silver | 4 | 6 | 3 | 3 years |
| Rosewill PHOTON-650 | $74.99 | 1 (54.2A) | Gold | 4 | 8 | 4 | 5 years |
| Aerocool VX-700W | $69.99 | 1 (54A) | None | 2 | 6 | 3 | 2 years |
| Rosewill HIVE-650S | $64.99 | 1 (48.75A) | Bronze | 2 | 8 | 4 | 3 years |
| Zalman ZM500-LE | $32.99 | 2 (20A) | None | 2 | 6 | 3 | 3 years |

**www.booksmania.net**

# Windows 10 Game Mode

For a vast majority of us, the OS installed on our PC is a means to an end. It's more of a tool shed: we get excited about what's hanging on its walls or what's inside, not the container itself. But as tool sheds go, Windows 10 seems to be evolving in ways that make what we do with our PCs better and more engaging. This month we're talking about Game Mode, one of the bullet points of Microsoft's Creators Update, slated to arrive in the spring. According to Microsoft, Game Mode is designed to increase the performance of games, regardless of whether you bought them on Steam, GOG, the Windows Store, a brick-and-mortar retail store, or anywhere else.

Last month's Software Tips & Projects article revealed some promising performance advantages for those running Win10 and a DirectX 12-capable graphics card. Microsoft has tied new versions of DirectX to the contemporary OS before, for instance, DirectX 10 and Windows Vista. But in addition to supporting any Win32 and UWP (Universal Windows Platform) title, Game Mode is API and DirectX version-agnostic, which means there should be benefits for Doom running in Vulkan or OpenGL, Microsoft's UWP-based Forza Horizon 3, Gabe "Windows-8-is-a-catastrophe" Newell's Half-Life 2 Episode 2, and any future installment of that franchise should hell freeze over and pigs take wing. So to recap, Game Mode can deliver better game performance, for all of our games, and the cost of admission is merely Windows 10. Where do we sign up?

## What Does Game Mode Do?

According to Microsoft, Game Mode aims to increase peak and average frame rates, or consistency. It does this by giving the crucial game processes priority access
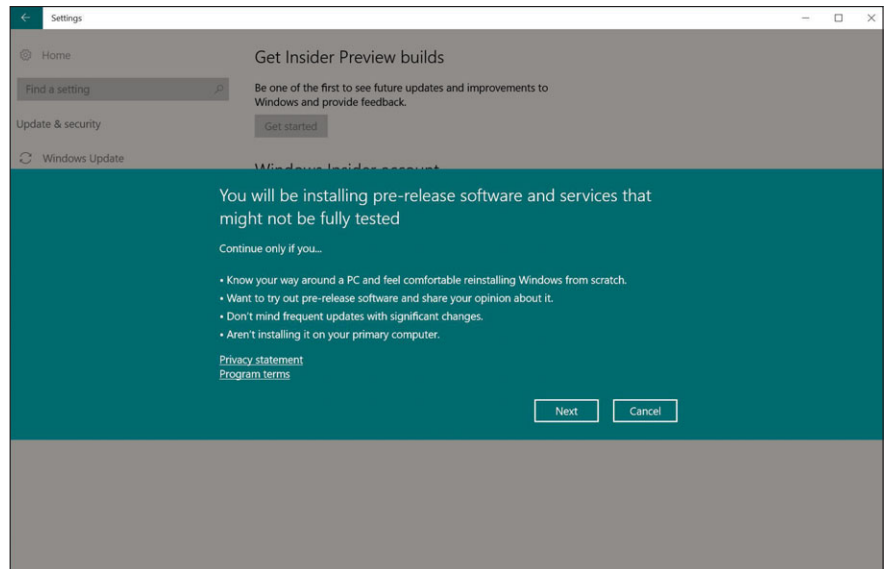


Right now, the only way to try the Creators Update, and its new Game Mode feature, is to install a Windows Insider Preview Build.

to the CPU and GPU resources they need when running in the foreground. As a result, background processes will necessarily run slower, but if you're like most people, the game will be running full screen and occupying 100% of your attention anyway.

Because the feature isn't quite ready for consumers, there's not a whole lot of documentation that details exactly how the OS gives games higher-priority access to system resources in Game Mode. As we went to press, there was no list of games that benefit the most, or even a range of performance improvements to expect. Given the varying ways in which games leverage system resources, we wouldn't expect every game to benefit in the same ways. At this point, we still don't know if Game Mode juggles background OS resources, those dedicated to third-party apps, or both.

Although there's a distinct lack of information from Microsoft, we're not

completely in the dark. Game Mode, as well as a few other notable features from the Creators Update, is currently available in a handful of the Windows 10 Preview builds, which any Win10 user can install and begin checking out at any time.

## Be An Insider

If you want to try Game Mode right now, ahead of the official launch of the Creators Update coming in the spring, you'll need to join the Windows Insider Program by visiting insider.windows.com and clicking the Get Started button. Microsoft has been using the Insider Program to deliver frequent updates and early software builds to particularly enthusiastic Windows users. As long as you're OK with software that may lack polish and, more critically, stability, the Insider Program is a good place to go to get an early look at what Microsoft has in store for the Windows platform. To
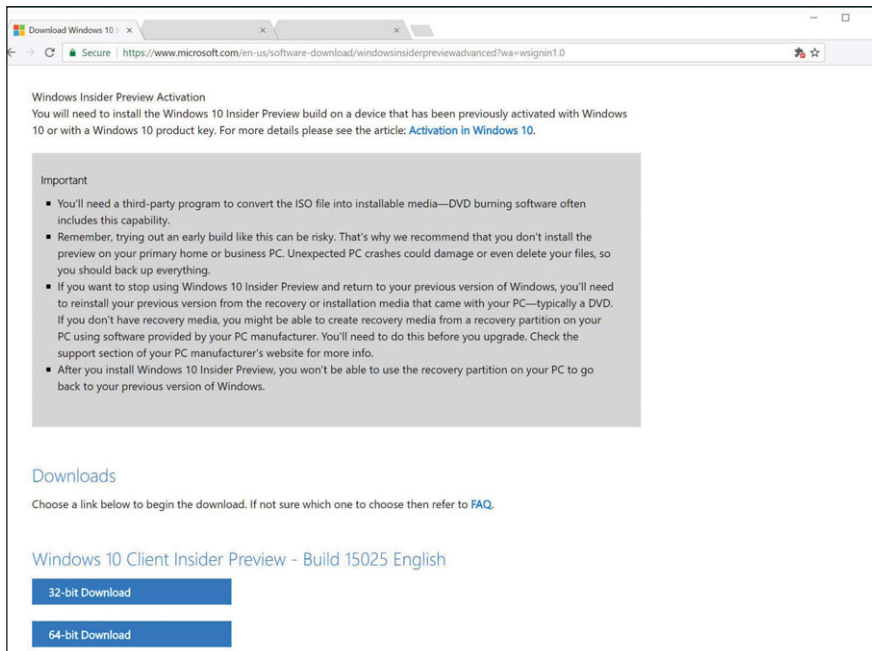
Start by signing up for the Slow Ring, but if that fails to result in the build you're looking for, install the ISO or opt for the Fast Ring.
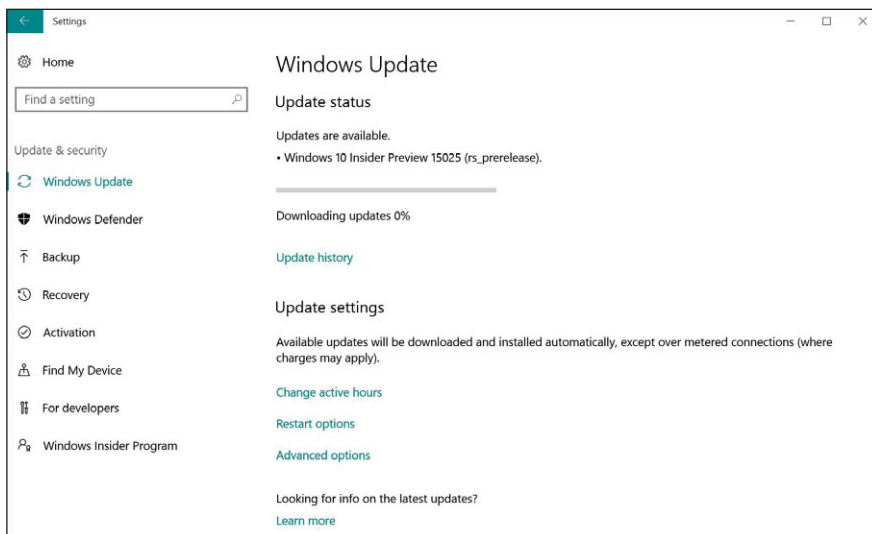


We signed up for the Fast Ring, which (eventually) let us download and install the Insider Preview 15025, including the Game Mode feature.

complete the sign-up process, just sign in with your Microsoft account.

The next step is to make sure you have the prerequisite Windows 10 Anniversary Update installed. To check, you can download Microsoft's Upgrade Assistant at bit.ly/2kpErZI. Double-click the executable to launch the app, and you'll either get a notification that you have the Anniversary Update installed or you'll be prompted to install it via the utility. Once that step is complete, click Start, Settings, Update & Security, and then click Windows Insider Program at

the bottom left of the window. If your Windows Insider account is already linked to your Win10 profile, you can click the Get Started button under the Get Insider Preview Builds heading. If not, click the Link A Microsoft Account button to activate the Preview Builds button and click it when you're finished.

## Beware All Ye Who Enter Here

Before you install a preview build, you'll be faced with a strongly worded warning that cautions users that proceeding may result in the need to reinstall Windows from scratch. You should probably not do this using your primary PC, and even if something doesn't crop up that prompts a complete reinstall, there will be some rough edges, and frequent changes are likely occur to the UI of the previewed utilities and features. If this warning causes you to hesitate, we recommend waiting for the official Creators Update. The warning screen also has hyperlinks for the Privacy Statement and Program Terms should you desire more information. If you're ready to install the latest preview build, click the Next button and then click Confirm to acknowledge that you are aware that a reinstall may be required if you want to remove a preview build from your PC. Restart your PC by clicking the appropriate button.

## Fast Or Slow?

If you installed the Anniversary Update, you probably don't remember coming across anything in the OS that designates the new features as such. So too, Creators Update doesn't appear in your update history; it's all about build versions. You can look up your build version number by clicking in the text box on the Taskbar and typing **winver**, then pressing ENTER. Before we installed our first preview build, our Windows version was 1607 (OS Build 14393.693).

If you're following along, you need to return to the Settings, Update & Security, Windows Insider Program screen. There will be a drop-down box below the Choose Your Insider Level. Use it to set select the Fast, Slow, or Release Preview Ring, which is how Microsoft's

Typing **winver** into the Taskbar search box and pressing ENTER lets you see the Windows 10 build version you currently have installed.

developer-centered posts refer to the different tiers. Selecting the Fast Ring is for PC experts only and results in newer features sooner, but there's a greater risk that you'll encounter bugs, inconvenient quirks, and (rarely) system-killing issues. The Slow Ring provides minimal risk to your installation, and the Release Preview Ring installs only updates for the current branch. This lattermost option is the default setting, but if we leave it as is, we won't get the Creators Update anytime soon. If possible, go for the Slow Ring. The only way to determine if the ring you chose will deliver the Creators Update is to try it out and see what Windows Update delivers.

After making your selection, Microsoft reports that a background process will launch to check your system compatibility and register it with the company's release system. It might take as many as 24 hours for the updates for your selected ring to arrive. On the Update & Security screen, click Windows Update, and then click Check For Updates, let them install, and restart your computer when prompted. After an update, we were running OS Build 14393.726, which was still not a preview build. As it turned out, we had to wait a day to get a prompt that a Windows

Insider Preview build was ready to install.

As we went to press, Windows Insiders on the Slow Ring were granted access to OS Build 14986.1001. Although considered a part of the Creators Update (this build included Microsoft's new Paint 3D utility), Game Mode doesn't get added to the mix until Preview Build 15019. Aside from running the "winver" command to determine the presence of the new feature we're looking for, you can go to the Settings menu and look for the Gaming icon. Sure enough, when we checked, it wasn't there.

## So Now What…

Although we weren't able to get an OS Build of the Creators Update with Game Mode on the Slow Ring as we went to press, things may have changed by the time you try it. The Slow Ring is definitely the safer option, so we recommend trying it first. If OS Build 15019 or later still isn't coming through on the Slow Ring, then you have two options: install it from an ISO or opt for the Fast Ring. If you chose the latter, choose Fast from the Settings, Update & Security, Windows Insider Program

screen, restart the PC, and then check for updates until a new build shows up. Incidentally, this is what we opted to do. If you're in more of a hurry, you can follow the instructions below.

## The Impatient Route

If you don't want to wait for a Game Mode preview build to show up, either on the Slow or Fast Ring, you can install one of a handful of Windows Insider Builds manually using the ISOs that Microsoft makes available. Before you proceed, make sure you have access to your Windows 10 product key, as you'll be prompted for it during the installation. If you want a quick way of looking up your key, check out a utility like the Magical Jelly Bean Keyfinder (bit.ly/Yi9BG0), which scans your Registry for the product key and displays it in handy text form. Next, visit bit.ly/2edph9N, sign in with your Microsoft Account, and then use the Select Edition drop-down menu to choose the build you'd like to install.

When you opt to download the ISO, start by selecting an OS Build 15019 or higher and your preferred language, then click the 32-bit or 64-bit hyperlink that corresponds to your current installation and wait for the 4GB download to complete. The next step involves mounting the ISO file to perform an in-place upgrade. Navigate to the ISO file using File Explorer, right-click it, click Properties, and then click the Change button adjacent to the Opens With command. Select Windows Explorer, click Apply, and then click OK. Now just right-click the ISO file, which for us
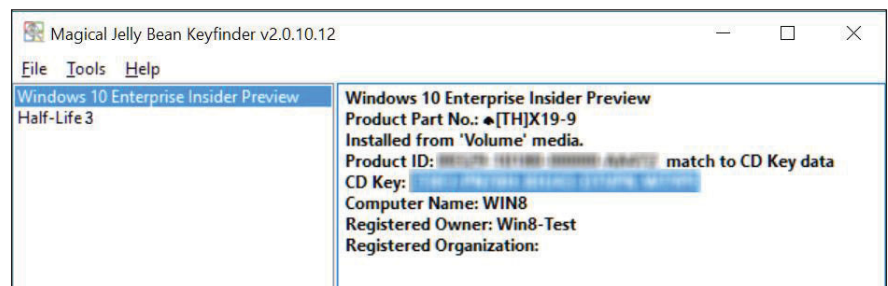


If you're installing from an ISO and don't have your Windows Registration Key handy, try looking it up using the Magical Jelly Bean Keyfinder.
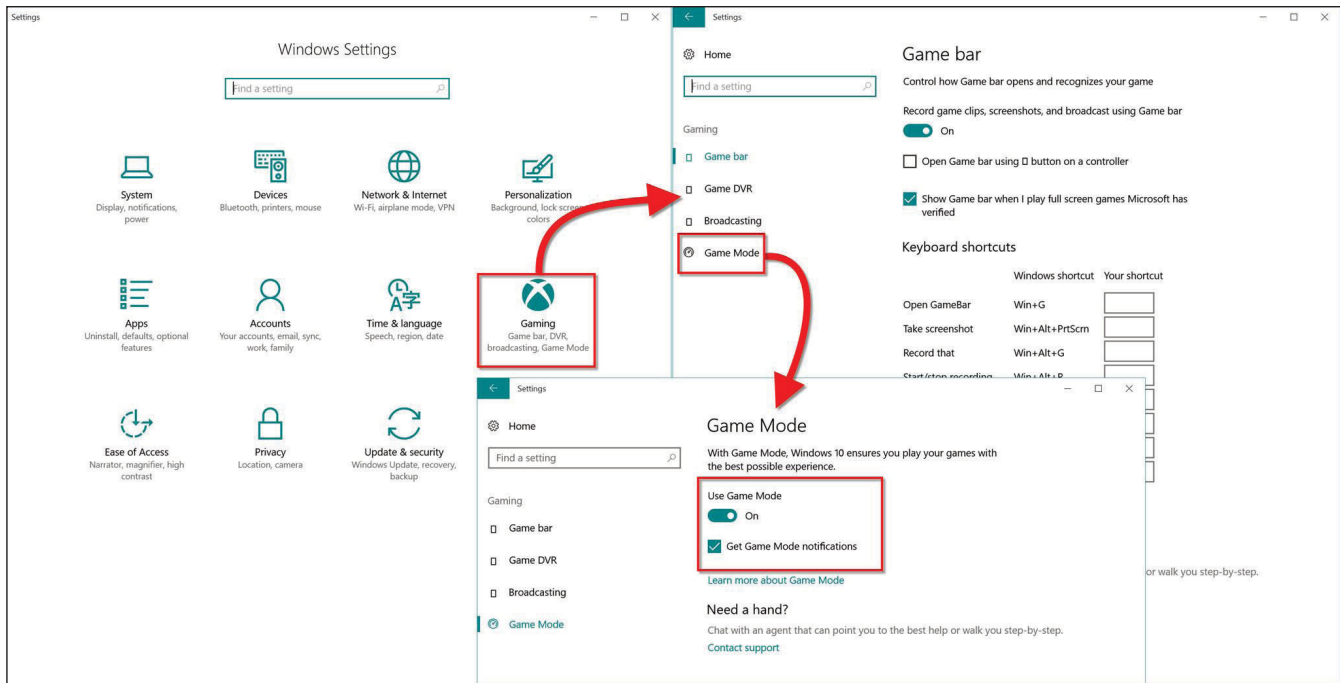
Access the new Game Mode feature by clicking Start, Settings, Gaming, then Game Mode.

was named Windows10_InsiderPreview_ Client_x64_en-us_15025.iso, and click Mount. To begin the installation, double-click the ISO file to open the contents in File Explorer, double-click Setup.exe, and then dismiss the UAC prompt by clicking Yes. If your machine is connected to the internet, leave the Download And Install Updates radio button selected and click Next, or click the Not Right Now button and click Next. Input your product key and follow the on-screen prompts to continue.

### Showtime For Game Mode

Finally, after much fiddling, we managed to get our hands on OS Build 15025. To toggle Game Mode, press the Windows key, click the Settings icon, Gaming, and then Game Mode from the menu on the left side of the screen. We also checked the Get Game Mode Notifications checkbox. The OS Build we were testing had a known issue where Game Mode was enabled by default, but the slider showed that it was in the Off state. Switching it to On kept the setting enabled, but the slider's status was accurate. Also make sure that the Game Bar toggle in the Gaming menu is set to On. To enable Game Mode on a per-game basis, you'll need to press the Windows key + G shortcut while the game is running, click the Settings icon, and then click the checkbox that enables Game Mode for the game. Although not specifically directed to do so, we restarted each game after enabling or disabling Game Mode.

Our test system consists of a 10-core, 20-thread Intel Core i7-6950X installed in a GIGABYTE GA-X99-Ultra Gaming motherboard with 16GB HyperX Predator DDR4-3000. We installed a lightly overclocked GIGABYTE GeForce GTX 1060 G1 Gaming. We wanted to make sure to hammer the graphics card as much as possible while still



Upon our first restart after successfully installing the Insider Preview, we got a Windows 10 Creators Update welcome message.

maintaining playable frame rates, so we tested everything at 2,560 x 1,440. Our storage subsystem consists of a 240GB OCZ Vertex 3 MAX IOPS SSD for the OS and a 1TB WD Black HDD. We're running the 64-bit edition of Windows 10 Enterprise.

It's pointless to use synthetic benchmarks to show the advantages of Game Mode, so we kept our testing focus on modern games that you'd be most likely to be playing as we went to press. Many of these games have a DirectX 12 running mode, but as we proved last month, AMD and NVIDIA cards don't benefit equally under DX12, so in every instance where we had the option, we selected DX11. The games we ran included HITMAN, Rise Of The Tomb Raider, Deus Ex: Mankind Divided, The Witcher 3: Wild Hunt, Dying Light (Windowed), and Middle-earth: Shadow Of Mordor. Although these are the games we recorded scores for, we also tested the feature with a handful of other games, including ASTRONEER, Ashes Of The Singularity, Forza Horizon 3, Halo 5: Forge, Sniper Elite 4, and Metro: Last Light.

For our testing, we recorded frame rates from several runs and averaged the three closest sets of scores. Those are the numbers that appear in the charts. In
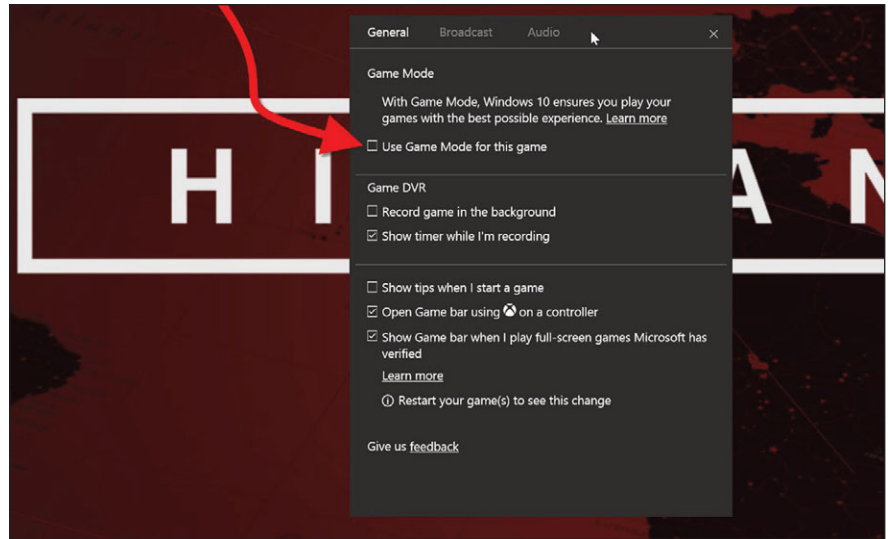


In the game, you'll need to press the Windows key + G to open the Game Bar, click the Settings Icon, and then click the checkbox that enables Game Mode. Restart the game to proceed.

the charts, we wanted to look at both average frame rates and the minimum frame rates, because these are the two areas where Game Mode is purported to have an impact. Additionally, because Game Mode's in-game toggle switch is accessed through the Game Bar, you won't be able to turn the feature on in any game that doesn't let you open the Game Bar. Most of the games we tried let us access the Game Bar, those that didn't would once switched to Borderless or Windowed mode.

## That's It?

As you can see, our results are more than a little underwhelming. Although there are some games that look like they benefitted, there are others that look like they suffer to the same degree. Game Mode failed to affect scores by more than a single frame or two, and as a result, we're not confident that the feature is having an impact.

We knew that Game Mode was going to be wet behind the ears when we started, so we fully expect Microsoft to

| Game Mode: Windows 10 Enterprise (Insider Preview Build 15025) | | | | |
| --- | --- | --- | --- | --- |
| Games (2,560 x 1,440) | Average Frame Rates | | Minimum Frame Rates | |
| | Game Mode On | Game Mode Off | Game Mode On | Game Mode Off |
| HITMAN (DX11, Ultra Detail, SMAA, High Textures) | 52.19fps | 52.37fps | 15.34fps | 14.76fps |
| Rise Of The Tomb Raider Mt. Peak (DX11, SMAA, Very High) | 55.70fps | 55.88fps | 29.31fps | 33.44fps |
| Rise Of The Tomb Raider Syria (DX11, SMAA, Very High) | 44.74fps | 45.22fps | 14.56fps | 21.04fps |
| Rise Of The Tomb Raider G. Valley (DX11, SMAA, Very High) | 44.71fps | 44.27fps | 26.14fps | 24.89fps |
| Deus Ex: Mankind Divided (DX11, 4xMSAA, Very High) | 15.70fps | 15.70fps | 6.5fps | 8.43fps |
| The Witcher 3: Wild Hunt (Vsync Off, Unlimited FPS, Ultra) | 43.67fps | 43.24fps | 39.33fps | 38fps |
| Dying Light (Windowed, High, AO On, AA On, Vsync Off) | 72.66fps | 72.21fps | 59fps | 61.67fps |
| Shadow Of Mordor (Borderless, Vsync Off, Ultra, DoF, OIT, Tess) | 64.13fps | 64.07fps | 48.05fps | 48.13fps |

**Game Mode: Average Frame Rates**
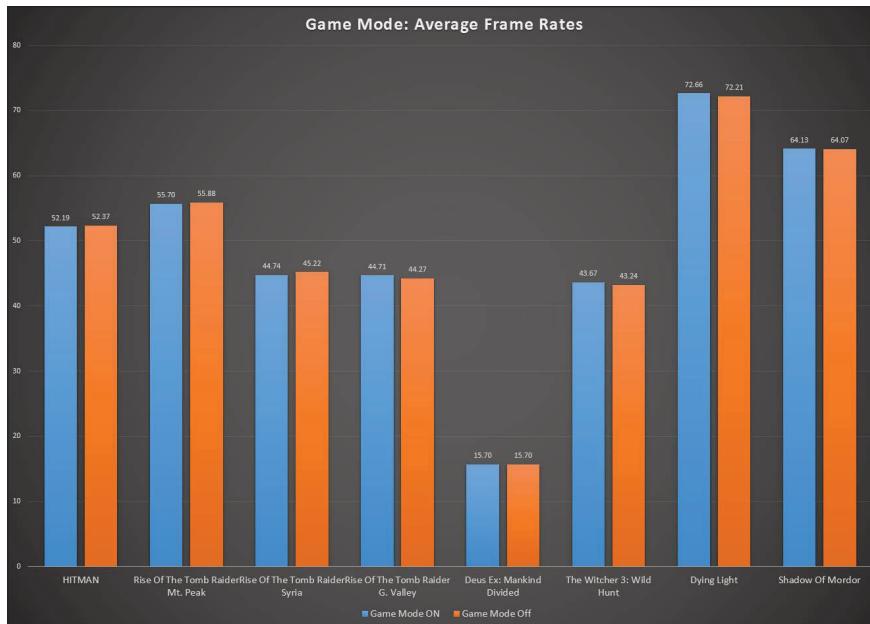
The Witcher 3: Wild Hunt was the only game that appeared to benefit from Game Mode in both average and minimum frame rates, but not by much.



**Game Mode: Minimum Frame Rates**
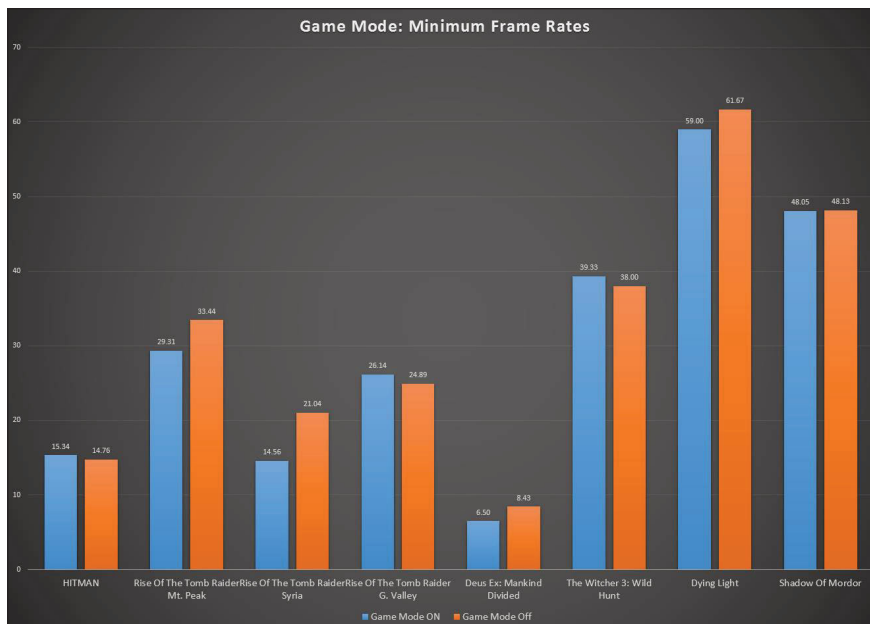
Only three of the eight scores showed higher minimum frame rates during our testing.

make improvements and tweaks between now and when the Creators Update arrives for everyone. But there's also a chance that our system, or high-end systems in particular, just won't benefit much. Using this as a working theory, we even disabled hyperthreading and Turbo Boost, and we down-clocked our Core i7-6950X to 2GHz, hoping it would become a bottleneck and force Game Mode to do something about it. Alas, it didn't affect performance at all. Which, if nothing else, serves as an indictment against using Intel's $1,650 processor (or any enthusiast-grade processor for that matter) solely for gaming.

### Lingering Questions

There are a couple of things we noticed while testing games with Game Mode. First, you can technically enable Game Mode for an app that is not a game, in the same way that you open the Game Bar by pressing the Windows key + G shortcut and using the checkbox to designate the app as a game. Could Game Mode be used to give any application a performance boost? Another question we have about Game Mode is whether the Game Bar needs to be accessible for the feature to work. In some instances, including Dying Light, we were able to force the full-screen game to run in a window using the ALT + ENTER shortcut, but back in full screen, we had no way of knowing if Game Mode was active. As we mentioned above, we checked the Get Game Mode Notifications checkbox from the Settings, Gaming, Game Mode menu, but we never once saw the notification pop up.

Another problem with our testing could have been the fact that we weren't running any additional applications while we performed the benchmarking. But if Game Mode only makes its presence felt when there's a bunch of stuff running concurrently with the game, then we'd argue that most enthusiasts and experienced PC gamers already put their PCs into a DIY game mode every time they play. As a rule, we also tend to steer clear of utilities that chronically consume more than their fair share of system resources, so it's possible that Microsoft's Game Mode didn't have a whole lot of headroom to recover wasted CPU cycles for us. We're not ready to close the book on Win10's Game Mode just yet, and in the coming weeks and months, rest assured we'll be keeping a close eye on the feature and any performance gains it might be capable of delivering. ∎

# Cord-Cutting In 2017

## Have "Cord-Nevers" Become Pay TV's Biggest Worry?

Ever since cord-cutting started to gain traction with users years ago, mainstream coverage, research, data, and debate have steadily flowed forth, posing issues such as how prevalent cord-cutting really is, what impact it's having on cable TV companies and television networks, and what the industry should do to react. What sometimes gets overlooked is that cord-cutting is an actual process, and people want advice and guidance from those who've already done it.

The following provides such advice—something becoming more important simply because there's never been as many streaming apps, services, and devices available to would-be cord-cutters, not to mention OTA (over-the-air) antennas to acquire free local HD broadcasts. Although users have historically viewed cutting the cord with their cable companies as a way to save money, these newer options and upcoming ones are leaving some to view cord-cutting as a path to better satisfy their changing viewing habits.

Despite this, Jared Newman, a "die-hard" cord-cutter who writes a "Cord-Cutter Confidential" column at TechHive.com, says cord-cutting is still something for some but not others. "I'm at a point where I wouldn't return to cable even if it was less expensive because I don't want to deal with the baggage," he says. That includes snaking cables around his house, constantly switching between a "clunky cable box" and "slick streaming devices," and "haggling with my cable company for a lower bill every year." Inertia, though, "is a powerful force upon cable subscribers," Newman says, in the sense "the more stipulations you have about cable, the more work it takes to come up with a suitable replacement." Additionally, "there's something to be said for just leaving well enough alone, even if it costs more. On



Many experts suggest that while the number of cord-cutters has been increasing for several years, it's still not for everyone. Several websites offer guides to help users determine if cord-cutting is for them, including Jared Newman's "Cord-Cutter Confidential" column at TechHive.com.

both sides, time might be more important than money," Newman says.

In addition to offering differing perspectives on cord-cutting, the following details other factors impacting the pay TV industry, including "cord-nevers" and "cord-shavers," two types of users some experts believe pose bigger challenges to the pay TV industry than cord-cutters.

### What The Numbers Say

Seemingly everyone agrees that cord-cutting is increasing. A recent report from GfK stated that about one-quarter of U.S. households now lack cable or satellite reception; 17% reportedly only rely on broadcast reception (think OTA antennas), up from 15% in 2015, while 6% only rely on internet-based services (think Netflix or Hulu), up from 4% in 2015. eMarketer recently predicted that one in five U.S. adults won't watch traditional pay television programming this year. The research group predicts households subscribing to cable, satellite, or telco TV packages will dip 0.7% this year to reach 98.7 million. By 2020, the total is predicted to fall to 95 million. "This year, 1.7 million U.S. adults will cut the cable/satellite cord, as many of them

opt for on-demand OTT [over the top] services instead," eMarketer states.

Combine such data with more streaming options, new OTA antennas that incorporate DVR abilities and easier accessibility to local broadcast stations, new entertainment-focused business models, and other developments, and some experts are predicting a dramatic transformation for the pay TV space this year. Others aren't as certain. "Is streaming increasing? Definitely," says David Tice, GfK senior vice president of media and entertainment. "Is cord-cutting increasing? Yes, slowly. But the changes aren't as drastic as some people suggest. Not all homes are going to drop pay TV for streaming or skinny bundles." Audience data, he says, shows viewers still devote a "vast majority of viewing time" to traditional TV programs. "It's definitely an industry challenge, but I think we'll see the market stabilize in the near future," he says.

Similarly, Jan Dawson, Jackdaw Research chief analyst, says cord-cutting is undoubtedly accelerating and "big pay TV operators are collectively losing more subscribers than ever," but cord-cutters are still a "small minority" compared to paid TV subscribers. Rather than instigating a dramatic transformation this year, Dawson sees cord-cutting as a "snowball rolling down a hill and getting bigger all the time." Every year will bring more viable alternatives to traditional pay TV, he says, meaning "more people cutting the cord and more financial pressure" on traditional TV players to offer more compelling options to subscribers. This year, for example, Dawson says new streaming services expected from YouTube, Hulu, and potentially Amazon and Apple could accelerate cord-cutting because of the brand awareness and audiences those companies have.

Dan Rayburn, Frost & Sullivan principal analyst and StreamingMedia.com executive vice president, also says cord-cutters represent a "very small fraction" of the overall market, and he doesn't believe this year will differ any from 2016, even with newer services such as AT&T's DirecTV Now and Hulu's expected live service coming to market. "It's just not going to impact enough of a portion of

the market to where it's going to transform or drastically change the paid TV market," he says. So, why do some articles suggest

the opposite? Rayburn says because headlines like "Cable TV Is Dying" attract attention. "You'll notice 99% of

## What's On & How To Find It

One complaint among some cord-cutters who turn to watching free OTA (over-the-air) broadcasts via antenna and programming via OTT (over-the-top) services like Netflix and Hulu is that it's not always easy or intuitive to see what's on and available. Numerous apps, websites, and other tools are available to help. TitanTV, for example, provides a free programming guide online and via mobile apps to view local broadcast lineups.

Other apps and websites enable searching multiple streaming services to access on-demand programming. Leanflix, flixfindr, InstantWatcher, and JustWatch are examples. JustWatch, for example, provides iOS and Android apps to use various filters (movies, TV shows, release year, genres, price, etc.) to search across Netflix, Hulu, Crackle, Tubi TV, HBO Now, and others. Further, a WatchList feature enables saving selections and provides rental and buying options.
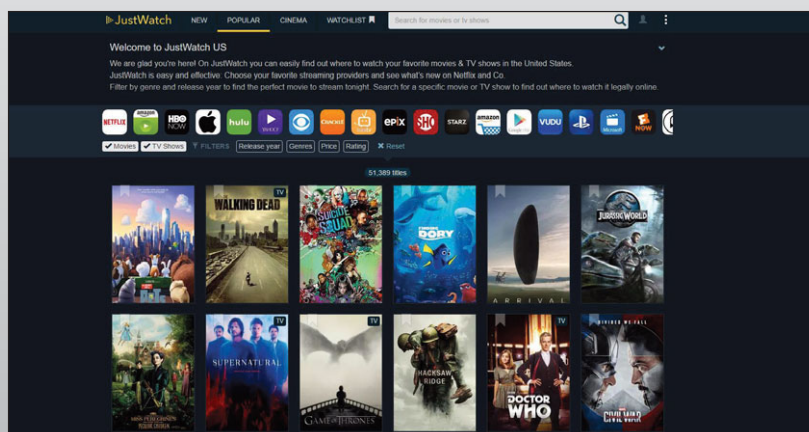


JustWatch is an example of the many apps, websites, and other tools available to make it easier to see what's available to watch through various streaming services. JustWatch provides numerous filters and icons for streaming services to help narrow searches.

Considering Netflix's popularity, it's not surprising there are scads of tools specific to that service to search its millions of titles. Flix Roulette is a more unique example, providing filters (director or actor's name, rating, keywords, etc.) and a Spin button to try your luck at finding Netflix content. Also noteworthy is the intuitive yet filter-rich FlickSurfer and What's On Netflix, which helps uncover highly rated content based on data from Metacritic, IMDB, and Rotten Tomatoes.

What's On Netflix also houses the "largest and most comprehensive list" of Netflix categories (3,500-plus) to search among. By using a specific URL (www.netflix.com/browse/genre/NUMBER) and "hidden" codes that What's On Netflix provides, a user can enter, say, the code 1155 in place of "NUMBER" in the URL to see titles under a Campy Horror Movies category. An extension for the Chrome browser called Netflix Categories puts several hundred in one convenient place, complete with the ability to bookmark favorite categories. Another Chrome extension worth considering is Netflix Enhancer, which enables hovering over a title in Netflix to display a pop-up that includes ratings, the option to watch a trailer (if available), and more.

the time when we read articles like that, they never talk numbers," he says. "The other thing is that it's almost kind of fashionable to say you hate your cable TV provider. Like, if you say you actually don't mind paying $120 a month for phone, internet, and cable, people think you're crazy."

One big red flag the pay TV industry is facing is a decline in consumption of linear content, including sports, especially among younger viewers, Dawson says. "People are abandoning traditional TV at an alarming rate, but that hasn't yet translated into abandonment of pay TV providers in the same numbers," he says. "For now, it's just about lower usage, but at some point that will cause those people to question whether it's still worth paying for a big bundle TV service, and then we could reach a kind of tipping point."

## The Case Of Cord-Nevers

Younger viewers currently are the center of great attention in this space. A GfK survey of 25,000 U.S. consumers found that millennials (18 to 34 years old) make up 43% of the "cordless" population, or those who have cut the cord or have never had a cable, satellite, or fiber-optic TV subscription. GfK says nearly one-third of all U.S. millennials are cordless vs. 16% of all Baby Boomers. Cordless millennials spend 65% of their viewing time streaming video via a TV set or other device.

Those users who've never had a cable subscription are known as "cord-nevers." Users who have moved to "skinny bundles"—less-expensive cable bundles with fewer channels or standalone OTT services—are known as "cord-shavers."

Fortune.com recently cited a report from PwC that found that households that cut the cord or have never subscribed reached 23% in 2016, up from 21% in 2015. Cord-shaving households that kept cable but reduced channels and costs climbed to 23% from 18%. "We saw more audiences customizing their pay TV
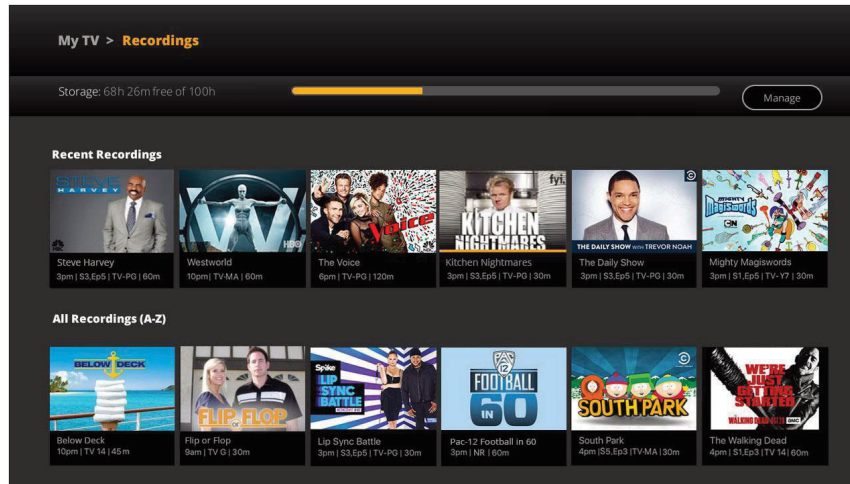


Cord-cutting experts tout so-called "skinny bundles," such as Sling TV and DirecTV Now, as a viable way to obtain specific content, such as NFL football action, while that content is in season and then cancel the subscription when the season is over.

bundles through trimming, even as they consume more content than ever before," PwC stated. "Their demands got louder in terms of what kind of content they pay for and how and when they access it."

"The affordability of paid TV is a big issue. However, before, there really wasn't an alternative that consumers could compare paid TV to. Now there is," says Colin Dixon, analyst and founder of nScreenMedia. "Increasingly, consumers are citing the fact that SVOD [subscription video on demand] services like Netflix provide a realistic alternative to paid television. In the past, that has not been the case." Effectively, he says, consumers are increasingly indicating traditional pay TV is too expensive and there are lower-cost alternatives to heavily rely on. "And that's exactly what people are doing. I think that's the biggest difference between now and, say, six years ago," Dixon says.

Like others, Dixon believes cord-nevers pose the greatest long-term difficulty

for the paid TV industry because they're typically younger and see no reason to subscribe to paid television. "What paid TV is providing doesn't relate to what they consider an entertainment choice," he says. "The idea of linear television and traditional television is just not of interest." This contrasts with cord-shavers and cord-cutters, who at one time did see value in paid television.

Broadly, Dawson says cable TV providers really want millennials and cord-nevers as customers. Thus, some cable companies aim special offerings at them, while "some of the OTT services we're seeing from pay TV companies like DirecTV Now and Sling TV from Dish are ways they're looking to tap in to this audience," he says. "They know they're mostly not likely to buy $100 per month pay TV services, at least for now, so they're trying to find other ways to reach them and generate at least some revenue from them."

Tice says cord-nevers provide a potential glimpse into the future. "The real interest will come if these young adults stay cordless as their incomes increase and they start families," he says. "If millennials don't want traditional cords as they become more affluent and have families, then pay TV companies need to come up with alternative business plans. This is why you see companies like Dish offer standalone streaming 'cable' services or see AT&T buy Time Warner—they can't just be pipes anymore."

For now, Toni Fitzgerald, managing editor of *Media Life Magazine*, believes cord-shaving will have the greatest impact on the pay TV industry ("you can already see it in the roll-out of skinny bundles"), but it's hard to say what the case will be moving forward. "My school-aged kids

## Straight From A Cord-Cutter's Mouth

Three years ago, Luke Bouma started CordCuttersNews.com to provide news, how-to advice, reviews, and other information concerning cord-cutting. Like many cord-cutters, Bouma ended his cable TV subscription initially to save money. Today, he says, cord-cutting decisions have as much to do with changes in people's viewing habits. We talked with Bouma about the cord-cutting lifestyle.

**Q: Do you ever regret cutting the cord?**

**LB:** You know, no. It's always funny when I go to a hotel because I travel a lot for business with the site now. I'm always like, "Man, I don't regret that." My daughter, who is four, has never known anything other than cord-cutting, and she cannot grasp this concept of not being able to watch the episode or show she wants to watch when we go to hotels. So, no. It definitely took a couple of months to find everything we wanted, to build our ecosystem of services, but once we put it all together, it was downhill from there.

**Q: What motivated you to start the website?**

**LB:** Three years ago, the coverage of cord-cutting was "it's not real." I got active on Reddit with the r/CordCutters sub-Reddit. I started posting a lot, and my stories were on the top, but I kind of didn't like the tone. They were all like, "Yeah, there might be a few kids in their mom's basement wanting to stream some stuff," but I was like, "No, I see something a little different." So, I created it to give my point of view on cord-cutting. The second week, we had almost 62,000 people come to the site in a single day. I thought, "We have something here." After the first year, I quit my job, and I've been running it full-time since.

**Q: On a daily basis, what do you try to provide?**

**LB:** There's kind of a two-pronged approach. First, it's just informing people of all things cord-cutting. News, new devices, new services. The news aspect of cord-cutting. The other is helping people become cord-cutters and helping them get the most out of the cord-cutting experience through guides, how-tos, reviews. That may be the secondary focus, but we get about 1 million people coming to the site every month looking for guides and reviews and "how can I become a cord-cutter?"
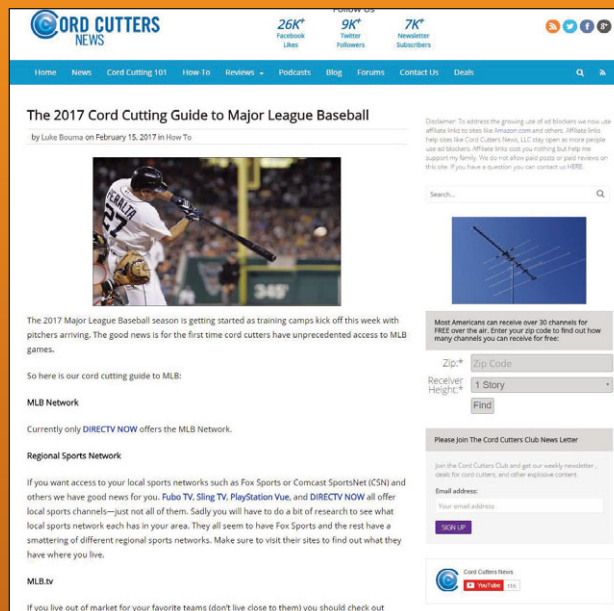


In addition to advice on cutting the cord, Luke Bouma's CordCuttersNews.com website provides numerous how-to articles that help cord-cutters navigate various situations, such as how to watch sports action without a cable TV subscription.

**Q: Are there certain traits you find cord-cutters share in common?**

**LB:** There really isn't one big basket. I have people in their 80s who are cord-cutters and people coming to the site who are 18. Age-wise and demographics, it's all over the place. I have seen a huge trend in the last year of more women being the lead in cord-cutting. My take is that a lot of women pay the bills and see how much they're spending. They may be the ones saying, "You know, do we really need to be paying $250 for cable?" That's been a big trend, but it's literally everyone. We did a survey of about 1,300 people, and over half were 45 or older. The other half was 30s and 20s. That goes against the grain of a lot of what you hear about, "Oh, it's a lot of millennials."

are cord-nevers," Fitzgerald says. "In two decades, I'd imagine most young people will be, as well."

### The Art Of Cord-Cutting

When Newman cut the cord years ago, his motivation was identical to that of many other cord-cutters: He was looking to save money, specifically after having just moved cross-country and beginning his career. Thus, he configured an internet-only TV plan. "Netflix was just starting to stream video onto TV devices like the Xbox 360, and Hulu was putting a lot of new TV shows online. Between those options and an antenna, we got by," he says.

Newman's configuration hasn't change much since. Netflix, Amazon Prime, and an antenna drive most of his TV viewing. "But the hardware has become more sophisticated with devices like Apple TV and NVIDIA Shield TV, and there are lots of new apps like PBS Kids, Pluto TV, and Crackle that help round out the streaming experience," he says. Newman also uses Plex DVR to record OTA broadcasts. "It's been so long since

having cable that I don't feel an urge to use skinny bundles like Sling TV and PlayStation Vue, but it's nice having those as options," he says.

Beyond saving money, Chris Brantner, a cord-cutter who runs CutCableToday.com, says users also end cable subscriptions to gain flexibility. "With cord cutting, you can try out a ton of different streaming services but never be locked into a contract," he says. "That allows your setup to be fluid, which is important in this seasonal world of television we live in." Someone who only needs ESPN during football season, for example, might subscribe to Sling TV for those months and then cancel. Some users who consider cord-cutting but then stick with cable do so because it's easier, he says. "You pay, and they come set it all up for you. It's a set-it-and-forget-it sort of thing," he says. Conversely, cord-cutting requires connecting an antenna and streaming device, deciding on services to acquire, and then likely balancing multiple subscriptions. "It's daunting for those not tech-savvy," Brantner says.

Elsewhere, some cord-cutters who subscribe to multiple services may find the cost savings they'd hoped for don't really materialize. Further, even subscribing to several streaming services might leave some content unavailable without a cable or satellite subscription. That's why planning and preparation are imperative to obtaining a satisfying cord-cutting experience. Brantner advises starting with must-haves. "What shows do you have to have access to? What channels do you need? What are you willing to live without? Once you have those in mind, you can build your cord-cutting package around it," he says.

Similarly, Newman says setups can depend on a user's mindset. Some users simply realize they're overpaying for cable because most of their TV-viewing time involves Netflix and Hulu. Someone who already uses a streaming device, such as a Roku model, and who doesn't mind some sacrifices can "save a lot of money without thinking too hard," Newman says. Other users will want to know how to ditch cable

## The Triple Cord-Cutting Threat

For many people, "cord cutting" signifies ending a cable TV subscription, but the term can also refer to doing away with a landline phone. Now, Ovum Research states we're entering a new realm of cord-cutting in which more people are discontinuing their home broadband internet connections and are instead only using mobile devices for connectivity needs. "This is the reason why U.S. service providers are diversifying their business away from their core services toward the path of becoming digital service providers," states Kristin Paulin, Ovum senior analyst. Ovum believes this is also why mergers and acquisitions will likely continue. One example is AT&T's proposed acquisition of Time Warner and the considerable video content and distribution assets that AT&T would gain.

Ovum's research, which covers the third quarter of last year, indicates telcos are particularly feeling the impact of this "triple" cord-cutting effect. AT&T and Windstream, for example, both experienced customer losses in their landline, cable TV, and broadband services, states Ovum, which also reports CenturyLink and Consolidated Communications are in risky positions due to declines in two of three areas. Verizon is in an "at-risk category" following declines in fixed broadband numbers in 2Q15 and 1Q16 and showing "very low" pay TV subscriber growth. "Most U.S. telcos have been losing fixed-voice subscribers for years but are now confronted with subscriber losses in either pay TV or fixed broadband, or both," Ovum states.

October-released data from Pew Research shows 13% of U.S. adults only used smartphones to connect to the internet in 2015 vs. 8% in 2013. Whereas 70% of U.S. adults had in-home broadband in 2013, the percentage was 67% in 2015. Saving money and increased smartphone capabilities were cited as leading reasons for the change. Of non-broadband users who own a smartphone, 59% reportedly cited broadband subscriptions as too expensive, and 65% indicated a smartphone does everything they need to do online. Also noteworthy, 59% of non-broadband smartphone owners reported having other options for internet access outside the home.

but without losing all their favorite channels and DVR. This poses more challenges and research, including probably comparing Sling TV to PlayStation Vue to DirecTV Now to evaluate what channels each offers, how the respective DVR services work, and if using an OTA antenna can compensate for a lack of local live stations. "If you're new to the world of streaming devices like Roku, you can easily become overwhelmed," Newman says. "Generally, the more you want something like cable, the more work you'll have to do to re-create it."

Various guides and tools are available online to help create cord-cutting setups. NoCable.org, for example, offers a Build Your Own Home Setup guide that poses several questions about the user's location, watching behavior, recording demands, internet service, and more. NoCable.org also offers a savings calculator to get an idea about costs.

Most advice to cord-cutters includes buying an OTA antenna to pick up free local HD broadcast channels and checking which local channels you can expect to pull in with the antenna in your region. NoCable.org states that 90% of the U.S. population is within range to stream free OTA HD television. AntennaWeb.org, TVFool.com, and Antennarecommendations.com all provide channel information, as well as buying advice for antennas and general cord-cutting recommendations.

For whole-home OTA viewing and DVR capabilities, Newman suggests looking at more sophisticated options such as the Tablo DVR and HDHomeRun. Other options include the upcoming Tablo Live, which promises to stream OTA HD channels via Wi-Fi to streaming boxes, smart TVs, and mobile devices in the home. The upcoming

Streaming devices like the Roku Premiere are a primary staple of a cord-cutter's setup, particularly when combined with an OTA antenna and major streaming service like Netflix, Hulu, or Amazon Prime Video.

Mohu AirWave, meanwhile, will deliver live OTA stations to an app on a user's streaming device, meaning he won't need to change a TV's input settings to watch live broadcasts. Elsewhere, upcoming Tablo Droid DVR software will enable owners of Android streaming devices, including the NVIDIA Shield Android TV, to record OTA broadcasts.

Overall, there isn't a one-size-fits-all approach to creating a cord-cutting setup. Thus, Newman suggests picking one or two "premium" streaming services such as Netflix, Hulu, or Amazon Prime as a foundation before rounding out what you need. "Treat yourself to a nice streaming box for your main TV—a Roku Premiere+, Amazon Fire TV box, Apple TV, or NVIDIA Shield TV—and leave the cheaper streaming sticks for the TVs you don't use as often," he says. Connectivity-wise, plan for a bare minimum of 10Mbps or more if multiple people will be streaming simultaneously, Newman says.

Currently, Dawson says everything is "flawed in one way or another, mostly because it's only a partial solution for cord-cutting. Everyone is missing channels, content, device support, and other elements that would make the services really compelling as replacements for traditional pay TV." Watching all the sports a user might desire, for example, might be really tough without subscribing to several different packages and probably still using an antenna for OTA broadcasts, he says.

## What's To Come

In the near future, absent of any market distortion activity—if the FCC, for example, stopped enforcing net neutrality and internet providers lowered broadband caps dramatically—Dixon believes "we're headed for big growth in cord-cutting and cord-nevers," particularly if consumers decide that streaming options are good substitutes for traditional TV. "You could see a much bigger number of people than just the typical 1% trickle away from paid TV over the next several years," he says. "You could see as much as 10 or 15% say, 'No, this is good enough for me' and jump to one of those services and drop traditional pay television. I think the way things are coming together will have a quite large segment of the population realize that they can really live without pay television."

For now, cord-cutters are still a small segment, but one that is growing steadily, Fitzgerald says. "More than that, though, there are a lot of people who say in surveys that they are considering cutting the cord, which I think is what's set off the fear," Fitzgerald says. "So far, you're only talking a few million people snipping the cord, but if you believe the surveys, it could be a lot more." That's if people follow through. "It's one thing to tell a survey taker you're fed up with your cable bill and quite another to follow through with the hassle of canceling service and finding a new source of TV entertainment," he says. ■



Along with the upcoming Tablo Live and other new releases aimed at cord-cutters, Mohu's wireless over-the-air and over-the-top AirWave device have been cited by some as having the potential to bring about a dramatic transformation of the pay TV industry this year.

# CPU
## Game Of The Month

Yeah, we know you have blogs to post, video to encode, reports to write, and code to compile. We do, too, but you have to take a break once in a while (and maybe blow some stuff up). That's why each month we give you the lowdown on what to expect from the latest interesting games.



# Messin' With Sasquatch

*BY CHRIS TRUMBLE*

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$59.99 (PC, XOne)   •   ESRB: (T)een
Microsoft Studios   •   www.halowaypoint.com

When the first Halo Wars launched for Xbox 360 back in 2009, it was a considerable step forward for RTS games played on consoles. Although it simplified certain aspects of base building and unit selection a little too much for some, it gave console gamers a really solid RTS experience and, of course, another chance to step back into the Halo universe. Now developers Creative Assembly and 343 Industries have unleashed that game's sequel, both on Xbox One and on Windows 10 PCs, and I'm happy to report that the game lives up to most if not all expectations.

If you recall, at the end of Halo Wars, the UNSC *Spirit of Fire* was left in the far reaches of space without a functional slipspace drive, effectively marooning her crew, which retreated to cryo-sleep in the hopes that they'd one day be rescued. As Halo Wars 2 opens, the shipboard AI, Serena, wakes Captain Cutter and informs him that "something has happened."

As it turns out, quite a lot has happened. The *Spirit of Fire* was declared lost with all hands by the UNSC, humanity's war with the Covenant ended, and 28 long years passed. As Captain Cutter and the crew wake up from their very long nap, they discover that Serena terminated herself at the end of her seven-year life span to avoid rampancy, as dictated by UNSC protocols. Her message pulling Cutter from cryo-sleep is a recorded note that was activated automatically when the ship received its first external communication in nearly three decades: a UNSC signal originating from Forerunner Installation 00, aka The Ark.

Long story short, the UNSC sent an expedition to The Ark after the war with the Covenant, only to have that expedition mostly slaughtered by
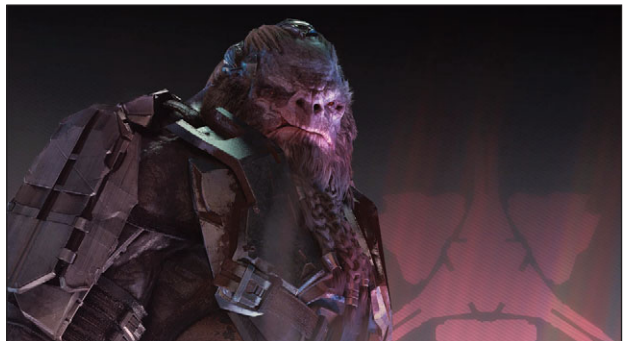
a new threat, an alien army known as The Banished. The Banished are a Covenant splinter group led by a ferocious Brute Chieftain named Atriox, who was formerly part of a Covenant suicide squad who a) refused to die, and b) rebelled against his Covenant handlers and was banished. (Hence the name.) Atriox is big and scary and, thanks to many raids against his former employers, very well equipped.

The campaign is a series of missions that tell the story of the small UNSC force's battle against Atriox and his army, and although for some the game will provide a less compelling connection to the characters and story than the Halo FPS games often do, it's unmistakably part of the Halo mythology and is a nice little fix for hardcore fans between Halo 5 and Halo 6.

The control scheme is improved on Xbox One over that of the first game in a couple small but effective ways: the graphics are markedly improved (as you'd expect), and Microsoft added several multiplayer options, including most notably the new Blitz mode. Blitz is based on a new collectible card system; your available units are based on decks you create from your collection and play during the game, rather than from bases you build.

Halo Wars 2 is a better game than its predecessor in every way, and thanks to Windows compatibility, keyboard and mouse fans will find it a lot more approachable, as well. It doesn't contain the complexity and moves-per-second rush that more mature PC RTS franchises do, but it's a lot of fun, and you can play on both platforms for one price. ∎

# An Apocalypse In A Teapot

### BY ANDREW LEIBMAN

$39.99 (PC: Vive/Rift)  •  ESRB: Not Rated
Jaywalkers Interactive  •  arizona-sunshine.com

Arizona Sunshine is one of the first full-length games built from the ground up for VR. It's safe to say that there's a risk involved in limiting your audience to people with high-end PCs who have gone on to pay up to $800 for an HMD. Whether willingly or not, Arizona Sunshine has become the de-facto poster child for full-length VR games.

At first glance, Arizona Sunshine feels like a game that was inspired by on-rails shooters with plastic guns straight out of '90s-era arcades. The setting is a series of locations in the desert Southwest. There's been a zombie outbreak, and the "Freds," as the player character refers to them, are everywhere. The game consists of fairly open arenas overrun with zombies, but you'll often need to find a key (or a lever, key card, winch, or other puzzle-solving item), then fend off wave after wave of the undead at the end of the level to proceed. We played the game using the Oculus Rift and Touch controllers, which double as guns that we could swap with other weapons we'd collected and holstered at our waist. Pressing the *A* button ejects an empty mag, and you can reload by bringing the gun to your belt. It's not the same as pointing away from the screen and pulling the trigger to reload like at the arcade, but it's close.

Although the weapon-handling mechanics are the key to surviving in Arizona Sunshine, that's not the first thing you'll struggle with when starting out. Traversal, the simple act of getting around in Arizona Sunshine, is a point of contention that highlights one of VR's biggest unsolved problems. That problem is, if you try to move around in a first-person capacity by pressing forward on a joystick (like you do in every other non-VR game), a vast majority of players will vomit. It's the reason some Oculus games come with the "Intense" comfort rating,

and it's a smoking gun for VR naysayers. Oculus, HTC, Valve, and Sony are basically saying that your fabulously expensive game system is likely to make you blow chunks if you attempt to play games like we currently play them on our 2D monitors and TVs.

But the developers of Arizona Sunshine knew this going in, which is why they made the default mode of transportation one that effectively lets you teleport yourself around by pressing forward on the left joystick and letting go. It's fast and effective, and we were able to play for hours on end without the slightest hint of motion sickness. But being a posterchild, Jaywalkers Interactive succumbed to the outcry and added a "walking" means of locomotion following the game's release. Although it's more immersive than teleporting, it's a hork fest after just a few minutes.

Is teleporting in Arizona Sunshine, or any VR first-person shooter for that matter, a deal breaker? For us, the answer is a firm "no." The experience we were left with in our time with this game, even in the face of a sometimes clunky interface, calibration issues that often prevented us from picking up things off the ground, cheesy voice acting, and some punishing difficulty spikes, was one that simply cannot be compared to any other 2D gaming experience we've had.

Arizona Sunshine is a flawed game, on a fledgling VR platform with even more flaws, but all of those criticisms dissipate like a red mist the first time you pop a Fred at close range and involuntarily flinch. There is a lot of room for improvement, but given how much fun we had with Arizona Sunshine, we're more excited than ever to see what's next. ∎

# Barbarians Without Borders

*BY VINCE COGLEY*

$29.99 (PC; Early Access)  •  ESRB: (R)ating Pending
Funcom  •  conanexiles.com



The fantasy genre has no shortage of memorable characters. You know them by heart—Harry Potter, Tyrion Lannister, Gandalf, and on and on.

Don't sleep on Conan. Most famously a barbarian, Conan has worn a lot of helmets (as it were) over the years, including usurper, wanderer, and freebooter. He's been adventuring in one form or another for 85 years, so after nearly a century, Conan's world is extensive.

If you're dreaming up an open-world survival game that is brutal to the core, you can't beat Conan. You'd also be out of luck, because Norwegian developer Funcom beat you to the punch. Launched into early access at the end of January, Conan Exiles puts players in Conan's backyard with little more than a loincloth—or, if you prefer, even less. (Let it be said that although the game doesn't yet have an ESRB rating as an early access title, it will most certainly earn a big, fat, boldface, possibly highlighted, capital "M.")

Conan Exiles presents players with lots of ways to customize their character while remaining faithful to the lore. You can choose from a number of in-universe races and pledge yourself to one of the world's handful of deities. Once you've created your character to your satisfaction, you're dropped into the Exiled Lands and must use your wit, savagery, and bare hands to avoid becoming a beast's dinner or an opposing player's target dummy.

Funcom seems to have a solid grasp on the fundamentals of a good open-world survival game. You can collect all the basics necessary for a rudimentary shelter in less than an hour, but the time and resources



required to build anything substantial really ramp up from there. So far, the balance between time invested and earned rewards feels about right. To access all of Conan Exiles' end-game goodies, you'll need a lot of work or a lot of friends—possibly both.

Comparisons to ARK: Survival Evolved, primarily, are inevitable, but Conan Exiles distinguishes itself with a pair of excellent mechanics, the thrall system and avatars. By capturing NPCs and dragging them back to your headquarters, you can break them on a Wheel of Pain (hey, we told you this is not a warm, snuggly environment) and have them do your bidding, helping you craft items or defend your base, for example. If you've aligned yourself with Yog, Set, or Mitra (three of Conan Exiles' gods), building a big enough shrine and performing enough rituals eventually lets you summon the corresponding deity and wreak havoc on the land. In Conan Exiles, it really feels like you're building an empire, which I imagine will be an incredible experience with a group of like-minded barbaric buddies.

Speaking of timesinks, Funcom has plenty of work ahead of itself. For starters, combat feels a little clunky. And of course, as an early access title, Conan Exiles has its share of bugs, ranging from annoying to game-breaking. Thankfully, Funcom has been responsive in rolling out hotfixes and patches, so we're hopeful the game won't slip into development hell. Without giving in to the hype (320,000 sales over the course of its first week), Conan has the potential to be the killer app that the open-world survival genre has been waiting for. At the very least, it really feels like Funcom has the right vision for Conan Exiles. We're looking forward to watching the game, and its player base, grow. ∎

# Boom, Headshot!

## BY ANDREW LEIBMAN

$59.99 (PC, XOne, PS4)  •  ESRB: (M)ature
Rebellion Developments  •  www.sniperelite4.com

For a while now, many historical shooters have been shying away from World War II, an era that games had done to death by 2006. But for the Sniper Elite series, the second world war is a part of its DNA as much as its third-person open-world gameplay.

Unlike most WWII shooters you've probably played, however, the third-person Sniper Elite Series is the slow, deliberate one that demands patience and careful planning. Games in the Call Of Duty franchise use scripted set pieces to punctuate dramatic moments, but as of Sniper Elite V2, this series' spectacle comes in the form of the slow-motion X-ray Kill Cam shots. When you pull off an impressive or particularly skillful kill, the camera follows the bullet as it leaves the gun's barrel and travels toward the target, where you're treated to an X-ray view of the slug puncturing the skull, splintering bones, and annihilating organs. It's a bit like DOOM's glory kills, but with Nazis. You can fine-tune the melee and bullet-kill cameras to none, minimal, reduced, normal, increased, and frequently and even enable "quick cameras." If you want to cut a kill-cam short, just press the Spacebar. Rebellion gives you plenty of opportunities to avoid the cameras if you want, but honestly, it's a big part of the allure of the game, so why would you?

It's important to take your time and strategize with Sniper Elite 4; your foes can hear gunfire and explosions and will go on high alert when they're suspicious. Using your binoculars, you can tag enemies; points of interest; and explosive barrels, ammo boxes, and vulnerable parts of enemy vehicles (they're red of course) to make it easier to track patrols (even behind walls), take advantage of environmental traps, and plan your route of attack. Whenever you fire an unsuppressed weapon, nearby enemies who hear will have a rough idea of where the shot came from. Take a second or third shot from the same position, and they'll be able to triangulate your position, and before long you may find your cover blown and a steady stream of reinforcements charging at you.

The exception to the "stay on the move" rule comes when you've found a sniper nest without nearby enemies. From those magical perches, you can cut down dozens of Jerrys and rack up points like you're pulling tricks in a Tony Hawk game. Points increase your rank and earn money, which in turn gives you access to weapon upgrades, skins, and new loadout options. We also love the fact that you can demoralize the enemy by taking out the officers first, or give yourself more of a challenge by saving them until the end of each mission.

Aside from sniper rifles, you have an SMG and a sidearm to deal damage at closer range, and while effective in many circumstances, you can't rely on them to get you through the swarm of soldiers. We know this because we tried it, and that sickening click click click of a gun with an empty magazine is the last thing you'll hear if you follow suit. Sniper Elite 4 is a slow-paced game, and you will fail if you try to play it like a Call Of Duty game.

If you're of the opinion that modern shooters could use a little more World War II and a whole lot less wall-running and jet packs, then Sniper Elite 4 is the breath of fresh air you've been looking for. ∎

Q&A With Matt Waite

# Exploring The Space
# Where Drones & Journalism Meet

Since late August when the Federal Aviation Administration enacted new rules for UAS (unmanned aircraft systems), or drones, journalists have been able to use the flying devices for newsgathering purposes, provided the journalist first pass an FAA test and obtain a drone operator's license. Previously, a journalist who wanted to, say, capture footage of a flood or wildfire from above had to obtain an aviation pilot's license to fly a drone for commercial purposes. The alternative was renting helicopter or airplane time to take aerial photos, something most newsrooms can't afford to do consistently. With the new rules, newsrooms can now obtain an affordable camera-equipped drone and greatly expand their coverage while simultaneously providing their audiences greater insight and different perspectives into their communities.

Matt Waite has been an integral figure in the use of drones for journalistic purposes. A principal developer of the Pulitzer Prize-winning website PolitiFact.com, Waite is currently a professor of practice at the College of Journalism and Mass Communications at the University of Nebraska-Lincoln where he teaches reporting and digital product development. In addition to creating a Drone Journalism Lab at UNL several years ago, Waite helped organize a sold-out Drone Journalism Boot Camp last summer that will expand to several other universities this year. Waite also helped create the Drone Journalism Lab Operations Manual, a freely available and open document that provides journalists with guidelines for safely using drones in the field. We spoke with Waite about the benefits drones can provide newsrooms and their audiences, privacy and safety concerns related to drones, and more. (*You can read our full conversation at* www.computerpoweruser.com/24120 )

**Q**: You have a strong connection with technology that started well before your work with drones, including working on projects involving web and app development. Has technology always had a presence in your life?

**MW**: Yeah, it's been pretty much a part of my life since the beginning. My dad worked at a software company that did telephone billing for small telephone companies. Some of my earliest memories are using old punch cards from mainframes as coloring paper. When he had to go down to the office sometimes at odd hours, me and my brother, or just me, he'd take us down there, and we'd sit on his lap. We'd be sitting in front of these old IBM mainframe terminals and these giant mechanical keyboards and he'd tell us to start typing stuff, and we'd be running these massive data jobs on these gigantic mainframes. We'd hit ENTER and all of a sudden these nine-track tape machines would start going crazy. We thought that was the greatest thing. So, yeah, since literally my first memories from the late 1970s, I've been around technology and knew it was going to be a part of everything I did, and I always saw technology as some sort of a super power to whatever I was trying to do. Half the time, I'm searching for excuses to learn some new technology in order to do the things I want to do.

**Q**: What is it about drones specifically that grabbed your interest, and when did you realize drones and journalism was something you needed to work on?

**MW**: It was sort of the perfect intersection of a lot of things that I had been looking at for a long time. In my career as a newspaper reporter, I was very interested in what we now call "data journalism," which is using databases of public information and analysis software to find stories that aren't immediately apparent. To find patterns in the data and reveal things that aren't clear to the naked eye. One of those techniques I was really interested in using was geographic information systems, so computerized mapping and using mapping almost as a database platform where you could do geospatial

analysis. In my time in Florida at the *St. Petersburg Times*, I did a lot of satellite imagery analysis. I was really interested in how we could use remote sensing to do journalism and tell stories and how we could use aerial imagery. There were all these sites that we were going out to while I was doing these stories, which were about how Florida's wetlands were being wiped out by development at the same time that state and federal regulators said they were not being wiped. We would go out to these locations and I kept thinking, "It would be great to get into the air. It would be great to get into the air where it would be better to see this. Even if it was just low altitude, it would be great."

But I sort of kept those thoughts to myself in the back of my head. There wasn't a lot I could do with it. Even in the sort of halcyon days of newspapering in the early 2000s when things hadn't totally gone to crap yet, you couldn't just go rent airplanes even if you wanted to. It wasn't until the summer of 2011 when I was at a GIS conference out in Southern California when I saw a company selling a drone that billed itself as a "fully autonomous aerial mapping platform." It was a fixed-wing aircraft with a camera on the bottom of it and a computer onboard. You programmed it by drawing a rectangle around a field on a tablet computer, told it where you wanted to take off from and where you wanted to land, and you plugged that flight plan into a computer and off it went. It would fly back and forth across that field taking pictures of the ground the whole time. The thing would land, you'd pull the memory card out of the camera, you'd shove it into that tablet computer, and it would stitch it all together into a high-resolution composite image of the ground. It would be geo-rectified so that you could put that into any geographic information system, any mapping system, and it would pop right onto the ground where it was supposed to be on the earth.

I thought of all the hurricanes I'd ever covered as a reporter in Florida and thought, "Oh my, we could be doing hyper-accurate damage-assessment stories

within a matter of hours after a hurricane goes through. I mean, we could do this faster than the government could do it." I was just drooling on the floor about that idea. So I ran over to the sales guy on the convention floor and said, "I'll take that one." He laughed and handed me my wallet back and said, "Well, they're about $65,000 each. And oh by the way, they are completely illegal in the United States." So, being sort of heartbroken about that, I couldn't put the idea away. It was this perfect intersection of data, of technology, of storytelling power, of being able to see things that aren't immediately apparent. It seemed like the perfect tool for investigative journalism. I couldn't walk away from it from that point on, and that's how it all sort of came about.

**Q**: You've written that "drones are an ideal platform for journalism." You also said in a TED talk that you believe drones will help journalists change how we see our communities. Can you expand on those beliefs?

**MW**: Even right out of the box with no real creativity or thought given to them, a drone is an extraordinarily useful tool for visual journalism. With anything that has any sort of large-scale extent—a tornado goes through a town, a flood happens, a big wildfire, all these different events that are large—unless you can see some perspective on them, they're really hard to sort of wrap your mind around as to how large they are. Well, you could take a drone straight out of the box, turn it on, go straight up into the air 100 feet, turn the camera on, just start looking around, come straight back down, and you've done a ton to open people's minds to how big or how far something goes. And that's even before you learned how to make it move forward. All you have to do is go straight up and down.

That's your opening move with a drone. You've vastly expanded people's idea of how big something is. That alone is worth the investment to get one, and we're talking anywhere from $1,500 to $4,000 for

a pretty good model that will do the job. When we start to expand it into using them for mapping or using different sensors on them to do remote sensing and start to be able to see things that aren't actually visible in the landscape and start revealing deeper meanings in our communities, that's extraordinarily powerful, and that's not a power that has been available to a lot of newsrooms. This is not a skill set that is common in a lot of newsrooms, to be able to do remote sensing analysis or to think about mapping.

I think the power here is clear enough that it is going to change newsrooms, and it is going to change the skill sets within them. And in the process, that's going to open people's minds up to what their communities look like from a different perspective, from a different scale. It will start to reveal hidden consequences of decisions, development decisions, or environmental decisions. It will start to give us an idea of how big things are or how far they extend out into the horizon or what kind of impact they have on the landscape because it's really hard to see those things from the ground. And now that pretty much anybody who can study for a test and pass it with a 70% score can put a flying camera in the air, that's going to increase the amount of perspectives we have into our communities, and that can only change the way we see them.

**Q**: You started the Drone Journalism Lab at the University of Nebraska-Lincoln. You also held a Drone Journalism Boot Camp last summer. What was the impetus for both of those efforts, and are there plans to hold more boot camps?

**MW**: Well, breaking news as we're talking, four more boot camps have been announced around the country for this year. They are at the University of Georgia, Syracuse University in upstate New York, the University of Wisconsin, and the University of Oregon. They will be happening at dates throughout the year. The announcement literally just went up, so we are going to continue

offering the boot camps. They are going to be expanding a little bit. Now they're going to involve faculty from the Poynter Institute for Media Studies and a more formalized involvement from the National Press Photographers Association and its general counsel Mickey Osterreicher, who is a fabulous guy. He was at the boot camp here in Lincoln, but the NPPA is now a formal partner and sponsor in the boot camps. I had hoped to do more last year, but time and opportunity slipped away.

said we were an educational institutional, and then a year later, they changed their mind and said education isn't covered as a government function. So we needed to go be a commercial operation, which meant going and getting a pilot's license, an actual manned aircraft pilot's license at the time.

I went out and did that—got a manned aircraft pilot's license—so I could fly a 3-pound hunk of plastic on the ground under FAA regulations. And then after I had done that, they of course

**Q**: You also created a Drone Journalism Lab Operations Manual. Why was that something important to create, and what does it entail?

**MW**: By the time the new FAA regulations that allowed for commercial drone use came about, we had flown drones in like six different countries in three different continents and had a fair bit of practical experience. It became pretty clear to us from just doing this that we needed to write down the best practices for what we do. How do you do things so you do them correctly every time? Safety, of course, is one of the foremost things. Making sure the drone is being maintained and the batteries are properly treated and so forth. And doing this across a group of people in an organization. A fair bit of time, the drone went overseas and I did not. It went with a student, so that student needed to know what the other students needed to know and what I needed to know. So it argued for formulization.

Then, as we were doing it and started to write things down and saying things like, "Before you go out on trip, you need to do this, this, and this. Before you turn the thing on, you need to do this, this, and this. You need to check that this is tight. Make sure this is attached. Make sure this isn't loose. Make sure the card in the camera is cleared off so you don't run out of space." Things like this. And we realized that if we need this, everyone needs this. And a manual was a way that we could immediately have an impact on the journalism field in a very practical and direct means. The Knight Foundation, which was our first and most generous backer—we had been working on sort of an ebook for them—we just realized that if we really wanted to have an impact that this was the way to do it. Just do this manual and make it freely available for everybody, and it would just jumpstart newsrooms all over the place. Have a process. Have policies. Have things written down that can help you make decisions, and then you can make decisions the same way every time. ∎

> # The Drone Journalism Lab . . . was started with the idea that drones were going to be a big deal in newsrooms, and because there were really unclear regulations or nonexistent regulations.

The Drone Journalism Lab was started with this very thing in mind. It was started with the idea that drones were going to be a big deal in newsrooms, and because there were really unclear regulations or nonexistent regulations and some distant promise of regulations down the road, we actually took time to do a little bit of study and see sort of what the practical and legal and ethical problems were going to be and how might we mitigate those before we even went out and started doing our first stories. It turned out to be a much more difficult thing to do actual in-the-field research because we were on the tip of the sphere with the FAA and its sort of confusion about how to regulate these things. They sent us a cease-and-desist order in the summer of 2013 because they

changed everything again and came out with the now-existing drone rules. It has been a wild ride, but mostly the lab is space in my office right now. Students come in and work with me on things, experiments and different things. We're going to be doing some licensing training courses for students in the spring. We'll have a course in the fall that will involve drones and 360-degree filmmaking. That's all learning coming from the lab that will influence that class. We've intentionally kept it really informal because everything was changing so much all the time, and half the time, we were involved in the very nitty-gritty regulatory changes, much to our chagrin. It slowed things way, way, way down from what we originally expected.

# Look For *CPU* At These LAN Parties

**03.03-04.17**
CogLAN 2.0
Columbus, OH
coglan.org

**03.03-05.17**
RGBLAN
Philadelphia, PA
www.rgblan.org

**03.10-12.17**
54 hour LAN Party!
Eau Claire, WI
www.awollan.com

**03.10-12.17**
PAX East*
Boston, MA
www.paxsite.com

**03.11.17**
SAN LAN Spring Edition
San Antonio, TX
www.sanlan.org

**03.16-18.17**
SXSW Gaming Expo
Austin, TX
www.sxsw.com/exhibitions/gaming-expo

**03.18.17**
Alaska's Ultimate Gamer
Anchorage, AK
www.facebook.com/events/417137185284178

**03.18-19.17**
Laclede's LAN 17
St. Louis, MO
www.lacledeslan.com

**03.18-19.17**
LANtasy 2017
Victoria, BC
www.lantasy.com

**03.18.17**
Oklahoma Gamers Group
Oklahoma City, OK
www.okgg.org

**03.18.17**
Source Gaming Lounge
Denton, TX
www.sourcegaming.org

**03.18.17**
Wichita LAN
Wichita, KS
www.facebook.com/kansaslan

**03.24-26.17**
PONG March LAN
Menomonie, WI
pong.uwstout.edu

**03.24-26.17**
Spring LAN-A-THON Under The Sun
San Diego, CA
SanDiegoLAN.net/LANaThon.html

**03.25.17**
eDrenaline eSports
Ashland, OH
www.facebook.com/groups/UGGeSports

**03.31-04.3.17**
ATRLAN 2017
Troy, NY
www.facebook.com/events/600287063477170

CPU

# Across The Nation—& Beyond!

*\* Event scheduled to include a CPU case mod contest*

**03.31-04.1.17**
LANFest NETWAR 32.0*
Elkhorn, NE
lanfest.intel.com/events/netwar32

**04.01-02.17**
Michigan Gamers for Giving 2017
Ypsilanti, MI
www.gamersoutreach.org

**04.07-09.17**
SpokLAN: GULP 17.04 - Nerd Side Story
Spokane, WA
spoklan.net

**04.07-09.17**
VectorLAN 8
Portland, OR
www.lanreg.org/pdxlan/vectorlan8

**04.08-09.17**
BoilerFrag 10.0
West Lafayette, IN
pugg.org

**04.08-09.17**
River Valley LAN
Russellville, AR
www.elayin.com

**04.15.17**
KCGameOn 74
Kansas City, MO
kcgameon.com

**04.15.17**
Oklahoma Gamers Group
Oklahoma City, OK
www.okgg.org

**04.15.17**
Source Gaming Lounge
Denton, TX
www.sourcegaming.org

**04.22-23.17**
Ultimate Gamer Showdown 3
Dauphin, MB
www.aybonline.com

**04.28-30.17**
DREAMHACK Austin 2017
Austin, TX
austin.dreamhack.com/17

**04.29.17**
eDrenaline eSports
Ashland, OH
www.facebook.com/groups/UGGeSports

**05.19-21.17**
BaseLAN 31
Winnipeg, MB
www.aybonline.com

**05.20.17**
Oklahoma Gamers Group
Oklahoma City, OK
www.okgg.org

**05.20.17**
Source Gaming Lounge
Denton, TX
www.sourcegaming.org

**05.26-28.17**
PAX West*
Seattle, WA
www.paxsite.com

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## Q&A With Eugene Kuo

# MSI Marketing Manager Talks G.A.M.E. UNLIMITED Desktop PCs

**Q:** So, you recently launched a new lineup of gaming desktops equipped with Intel Kaby Lake processors, right? You've referred to the new desktops as "G.A.M.E. UNLIMITED." Can you tell us what that means?

**EK:** G.A.M.E. UNLIMITED is what MSI is trying to bring to the table with the latest Intel 7th Generation Gaming desktops. G.A.M.E. stands for Gaming Performance, Absolute Gaming DNA, Magnificent Audio, and Essential Connectivity. We are implementing all the feedback from gamers around the world into our products.

**Q:** OK, let's start with the first aspect of the name, Gaming Performance. What do your desktops offer specifically in the area of enhanced performance?

**EK:** Our goal with gaming performance is very simple: getting you the highest FPS to play the latest games. We implement this by including obviously Intel's latest Kaby Lake processors, MSI's award-winning GeForce GTX 10 series gaming graphics cards, and a variety of features and functionalities such as Silent Storm Cooling to help keep your temperatures low and Game Boost for no-nonsense overclocking.

**Q:** Generally speaking, increased performance also equals increased heat and noise. You mentioned Silent Storm Cooling; that's something designed to address these factors?

**EK:** With what we call "Silent Storm Cooling," we separate the desktop into two or three chambers to keep the heat from each component away from the others. This keeps the temperatures cooler, which in turn helps keep the noise of the fans down. For example, the Aegis Ti3 separates the GPU, CPU, and PSU into three separate chambers.

**Q:** Do you sell the Dragon liquid-cooling system separately for builders who are interested, or is it strictly available in MSI gaming desktops?

**EK:** At the moment, we do not sell our Dragon liquid-cooling systems as a standalone product. However, if there is enough interest we might consider it.

**Q:** Moving on to the second component of the G.A.M.E. acronym, Absolute Gaming DNA. Can you explain to readers what that means?

**EK:** MSI is all about gaming. We pour thousands and thousands of hours into playing the games we love at our company, and our products reflect that. When developing our desktops, we sought input from a variety of gamers of all types, from casual gamers to pro players. By doing this, we were able to adjust our products accordingly and are able to provide the features and functionalities that real gamers are looking for. For example, our vertical video card design not only helps with preventing video card sag or broken PCIe slots, but also showcases the aesthetics of the Twin Frozr VI GPU Cooler, as well.

**Q:** Your new lineup includes several small-form-factor units, and sometimes SFF rigs can be tightly packed affairs with components that are hard to get to. What did you do with your desktop designs to avoid this problem?

**EK:** A lot of gamers are looking at SFF rigs these days. Desk space

Three of MSI's new G.A.M.E. UNLIMITED desktop PCs: the Aegis Ti3 (left), Aegis 3 (top right), and the Trident 3 (bottom right).

is always a very valuable resource, so we took it upon ourselves to create a product that could be both small and powerful at the same time. If you look at our Trident 3 mini gaming PC, the design and layout of the internals were made in a very purposeful way so that they'd still be very easy to upgrade. There are a lot of DIY SFF rigs out there that have definitely impressed us, but we've also seen many that are very cluttered inside. Our custom solution gets rid of a lot of that clutter, as we are able to custom-design and custom-build our desktop from the ground up.

Q: What can you tell us about MSI's Mystic Light feature?

EK: Mystic Light is our RGB LED feature. You can control both the interior and exterior lights through our gaming app, which allows you to choose different colors and modes to fine-tune how you want your MSI desktop to look.

Q: The third component of the G.A.M.E. UNLIMITED formula is Magnificent Audio. What does that entail?

EK: Audio is one of the biggest things about gaming. To truly immerse yourself and enjoy a game, the audio needs to be at a top-tier level along with your graphics. We implemented a suite of audio enhancements (both hardware and software) such as Audio Boost, ESS Sabre, and Nahimic Sound enhancer to deliver the highest-quality audio to your ears.

Q: We've read a little about Nahimic's audio technology in conjunction with MSI motherboards; can you talk a little more about what it does?

EK: Nahimic Audio was actually something that the French Army first adopted for its aircraft training simulators. We took that technology and brought it to our products to offer gamers a 3D sound effect to help them better hear where certain sounds are coming from. If you are playing an FPS game, Nahimic will enhance the directional output of the sound so you can get a clearer idea of the location it came from.

Q: Finally, G.A.M.E. UNLIMITED includes Essential Connectivity. Is

that more or less a fast LAN connection, or is there more to it than that?

EK: To many, the gaming desktop is the central hub of all their tech. Almost everything is plugged into it. Aside from a fast Killer Network LAN/WLAN, we implemented a variety of different connection options, including USB 3.1 with Super Charger 2 (for fast charging of your mobile device), USB Type-C, and even a VR link to plug your VR headset into the front of the desktop instead of having to always reach around the back to plug it in.

Q: OK, so what does Dragon Eye 2.0 do?

EK: Dual monitor configs are becoming more and more common in gaming setups, but for those who only have one monitor, Dragon Eye 2.0 is a program that allows you to watch movies or streams/guides without having to ALT+TAB between windows. It creates a small picture-in-picture that you can position and resize however you like it right on top of your current game.

Q: That sounds great. Where can readers go for more information about MSI's new Kaby Lake-equipped desktop PCs?

EK: You can check out more at our website: https://us.msi.com/Landing/msi-kabylake-gaming-desktop.

Q: Is there anything else you'd like readers to know about your G.A.M.E. UNLIMITED systems?

EK: Currently we are offering a sweet promotion that can net you both For Honor and Tom Clancy's Ghost Recon: Wildlands—plus the Wildlands season pass—if you buy an MSI gaming desktop. You can find more info at https://us.msi.com/Promotion/for-honor-ghost-recon-wildlands-bundle. ■